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EDITORIAL NOTES.

The Coming Demonstration of Progress.

WITHIN a calendar month from now, the National Gas Exhibition will be opened. Of this fact the men of the gas industry, we hope, need no reminding; for it is expected that everywhere arrangements are being instituted to make the utmost possible use of the demonstration, to the advantage of the entire industry. But during the past week we find from the newspapers that there is something in common between this exhibition by a single industry and the great British Dominions Exhibition that it is proposed to hold in 1915. The objects of the latter exhibition are twofold. In the first place, it is intended that it shall demonstrate the progress that has been effected in the manufactures of all parts of the British Dominions—taking stock, so to speak, of industrial progress; and, in the second place, it is intended that it shall be instrumental in stimulating trade within the Empire, by showing what each component part of it can produce and manufacture. From this 1915 exhibition, too, politics are to be entirely eliminated. These are precisely the plans and aims of the National Gas Exhibition. The gas industry is out to show the country, in the best of possible ways, the great progress that has been made in the application of its prime product, both in manner and in new directions; and, in the next place, it is hoped, and with large confidence, that the exhibition will further stimulate the trade of the industry. Thirdly, just as politics are entirely eliminated from the 1915 exhibition, so from our National Gas Exhibition competition has been eliminated; and gas suppliers and gas appliance manufacturers have combined, not to show the superiority of the particular productions of firms, but to demonstrate to the community—in a way, and on a scale, that individual firms could not do—what progress the industry has made to this point, and its largely developed ability to serve the community and the industries of the country. In all this, there is great practical value.

In all forms of business it is a good thing to take stock, and make a careful survey of the position in relation to one's competitors. If this is not done, there is a likelihood of an immense amount of self-deception, and a rude awakening may be in store. There are "milestones" in every class of business and in every industry; and, in all, those in responsible authority must see to it that everything is up-to-date and abreast of modern requirement. In the gas industry, there is no question in the present day as to the up-to-date work of its manufacturers. There have been isolated instances of a falling behind in the race; but there has fortunately come that irresistible stimulation—dissatisfaction of customers, and loss of commercial ground. We are sure without qualification that this has been a good thing; for some of those who fell behind in the race for higher developments in efficiencies and applications have profited by the poignant lesson, and are again leaders in the character of their goods, and in the struggle for continued equality, if not for supremacy. Just as it is wise for one manufacturer to survey his own conditions in contrast with those of his fellows in the same line of business, so it is wise for those in an industry to prudently compare its general position with that of a competing industry. But there is another side to this; and it is to provide the means for others to make a similar contrast. While it is easy enough for those living in the gas industry who are not constantly in a comatose state to take stock of the conditions affecting its progressive work in efficiency and application, it is not so easy to keep the community so thoroughly informed of these conditions that they can fully appreciate them. In ordinary businesses, the shop window plays an important part, in addition to advertisement, in informing the public of the change of fashions and of new inventions. But the goods of the gas industry require something more than their mere display with price tickets attached. They want effective demonstration; and this demonstration they will get next month at Shepherd's Bush.

In one way, gas supply suffers from being an old-established industry. It had not the advantage of birth with the experience and advancement of a parallel industry before it. The electrical industry must acknowledge that, at its advent, the experience of the manufacturers of metal fittings, glassware, shades, and so forth for gas lighting was of considerable benefit to it. The gas industry had alone, without precedent, guidance, or anything else, to "make its "way;" and the knowledge of the times produced what we now regard as somewhat remarkable pieces of crudity. The environment of limited knowledge and discovery persisted without much expansion for the best part of three-quarters of a century, with the inevitable result that, with all the energetic effort of the gas industry, many people in every district still associate it with old inefficiency, and have no knowledge of the new modes, fresh applications, and refinements. There we have one of the reasons—and it is an important reason—for demonstration on the large, effectively arresting scale. It is to the interest of our competitors to foster the belief as much as possible as to the continuance of crudity in the gas industry. It is the interest of the gas industry to make known its refinements and efficiency in every department of gas application—whether of light, heat, or power.

The industry has to reach those outside its pale who still sit in darkness as to its doings. It has to show, in respect of lighting, that the family likeness in gas-fittings—and gas-fittings of the plainest order, without any claim to artistic beauty—has departed, and that there is now unexcelled merit in the style of fittings for all situations, even to the choice adjuncts of the new indirect lighting system. The National Gas Exhibition will offer the proof of this. The gas industry has to show its fitness for illumination work in all places. It will do so at the National Gas Exhibition by its extensive range of high-power and low-power light units both for high-pressure and for low-pressure gas. The gas industry has to testify to the quality of its illumination. It will do this at the National Gas Exhibition. Despite the large adoption of gas cooking, there is much more work to be done in this line—including defensive operations. There will be much done in this way at the National Gas Exhibition. A promising land is domestic gas-heating. The gas industry is doing well in this line; but many there are who want the proof of the banishment of the congenital troubles and defects of quondam types of fires. The National Gas Exhibition will take an effective part in this work. Central heating of large establishments by means of gas is as yet little known. Information on this head will be available at the National Gas Exhibition. Water heating by isolated appliances and on the circulating principle require the dissemination of more intelligence concerning it by proper demonstration on the large scale. It will get it at the National Gas Exhibition. The same with the industrial uses of gas. Our country teems with manufactures in which heat is required; and day by day we hear of the use of gas for heating breaking out in fresh directions in industry. In regard to power, there are far too many of the old type engines in existence to be good for the reputation of the gas industry; and manufacturers require to know more of what has been done to gain mechanical and working efficiency by improvement, and to make the gas-engine as easy to start and as positive in action as the electric motor. The National Gas Exhibition will tell, by demonstration, of these advances.

Competition, as we have said, will be eliminated from the exhibition as between the gas appliance manufacturers. There will be no visible sign of competition of any kind, other than that which will be traced in the proof that the gas industry can for most purposes in which light, heat, or power

is required supply the need in a more economical manner, and with greater efficiency, than its competitors—whether electricity, oil, coal, or producer gas of any kind. The exhibition will create more respect, through the enlightenment it will afford, among industrial competitors than anything else has ever done. It is to represent the gas industry, and it will show, on a scale and in an unprecedented manner, the progress to date of the industry in the applications of its primary product. If there is any unit of the industry drawing profit from its advances that is not rendering help towards the success of the exhibition, or does not intend to do so, there is room for regret. Other industries recognize the importance of making periodical extensive displays. Our prominent men of industry, as well as leaders in the political world, recognize the importance, in the interests of stimulating trade within the Empire, of holding a gigantic exhibition in 1915. The gas industry recognize a powerful influence in the National Gas Exhibition, which will be fully in evidence in a month from the present time.

The Parliamentary Session and Gas Legislation.

THE day on which the last parliamentary session came to a close, a large batch of private measures (among them several Gas Bills) received the Royal Assent. It had been a comparatively short session, and a busy one in public matters; but in the Private Bill line, things had been decidedly tame, not owing to any particularly noticeable diminution in the number of promotions, but rather due to the combined facts that there was not any large showing of private measures of the first importance, and that our leading consultants are now advocating more than ever the peaceful mode of personal conference for the solution of difficulties between promoters and those in opposition on any point or points. So much so has settlement by negotiation been the order of the day during the past session, that our "Notes from Westminster" and our "Parliamentary "Intelligence" have, by their aggregate brevity, pictured the dearth of contentious matter and the friendly agreement behind closed doors. As a matter of fact, so much has been accomplished in this way, that, until we have the Acts at command, it is safer not to make any pretensions at reviewing the work of the session, but simply limit ourselves on the present occasion to its general trend.

There has been further extension of the areas of gas undertakings, and amalgamation of smaller concerns with larger ones. The attachment of the Enfield undertaking and area to the Tottenham and Edmonton Company, the Christchurch Company's property and area to the Bournemouth Company, and the purchase of certain concerns by the Grays and Tilbury Company are representative of this. The acquisition of electricity supply powers by gas companies has been a prominent feature of the session—Tottenham (in Wood Green), Herne Bay, Westgate and Birchington, and other concerns having been successful in this regard. The instances of transfer from the illuminating power standard to a calorific power one in the session will help to "set "the ball rolling" a little faster in this direction. The Corporation of Morley, the Redcar and Coatham Company, and the Porthcawl Company come to mind as now possessing calorific standards as the result of the work of the session; but the Redcar and Coatham Company have also an illuminating standard of 12 candles. The dual standard is a mistake that we hope will not be again committed. The West Bromwich Corporation have now a 13-candle power standard. Session after session now continues to build up the evidence as to the old illuminating power standard receding from the estimation of Parliament, as it has long since done from that of the major part of the gas industry; and session by session, we shall now hope to see the adoption of the calorific power standard proceeding at still faster pace. County Councils commenced the session by urging the right, as they have been consistently doing in the past two or three sessions, to abnormal powers in connection with pipe-laying. But their operations at Westminster have not been very successful, and as the session advanced there was less persistency in their claims. The London County Council obtained for the Metropolitan Borough Councils the right to make the necessary connections to privately owned buildings for the purpose of the central suspension of street lamps and bracket lighting. These are only a few incomplete notes, pending the opportunity of presenting the session's record in a more thorough manner.

We are looking forward with a greater amount of hopefulness to more substantial work in the session of 1914. If the Gaslight and Coke Company proceed with the suggested application for the abrogation of their illuminating power standard, and the retention, possibly with revision, of their calorific value standard and conditions; if the negotiations for a large amalgamation prove successful; if a company of front-rank position promote a Bill for the conversion and consolidation of their capital; if the companies with chemical clauses in their 1912 Acts and Orders decide to ask Parliament for the repeal of these clauses; and if other proposals that are on the *tapis* develop—well, there will be at any rate more gas feature next session than there has been in the one just ended.

The Coalowners' Profits.

WHILE realizing that the conditions of the South Wales collieries may be somewhat different from those in other areas, also that all collieries do not enjoy a uniform lucrativeness, we may take it that the financial circumstances and policy of the Fernhill Collieries, Limited, with such a representative owner at the head of affairs as Mr. D. A. Thomas, fairly well portray the commercial tendency from the side of the colliery proprietor. At the meeting of the Fernhill shareholders last week, Mr. Thomas had much to say respecting the weight of the costs of modern legislation and higher wages; and he admitted, in the frankest possible manner, what has been held to be the case in these columns all along, that the colliery proprietors do not suffer an iota from all this increased cost, but pass it all on, with the utmost complacency and consistency, to the consumer. This is perhaps bluntly stating what Mr. Thomas actually said. His words were that coalowners "could, within the limits of foreign com- "petition, pass these increased costs on to the consumer." The price of coal shows that, what the colliery owners "could" do, they have done; and, looking at their dividends, they have done it with a considerable margin to their own advantage. Foreign competition in coal is not much to be feared here at present, judging from the financial results of the experiments made in the comparatively recent past. Mr. Thomas's statement is, therefore, an open confession that the coalowners are subject to no control whatever—not even to that of foreign competition; and the position is really a serious one for the public. The acknowledgment made in this respect is not the only one. The shareholders of the Company rejoice together over the payment of a 16 per cent. dividend, as well as over the declaration that the Directors could have paid 30 per cent. if they had not inclined to the cautious policy of only recommending a dividend which they believe can be maintained in the future. The 30 per cent. carries its tale; and if the Directors are hoping still to maintain a 16 per cent. dividend, the position looks particularly healthy for the shareholders, and particularly ominous for the consumers of coal. Much has been said lately as to the signs of prices receding; but when we learn from Mr. Thomas that contracts for coal are being made for next year at figures substantially higher than was the case this time last year, it does not look encouraging for coal consumers, whatever it may be for coal proprietors. There are signs, too, of a further desire on the part of the South Wales miners for (agreements notwithstanding) sharing still further with the owners in the higher profits of the present. But the miners are already doing very well; for whereas in 1896 the average rate of wages was 11 per cent. above the standard of 1879, to-day it is 60 per cent. above the standard. In view of the condition of the funds of the Miners' Unions, it is not anticipated that there will be any national coal trouble in the immediate future, and some of the leaders are deprecating extreme measures over purely local issues, or issues raised without the full assent of the Unions.

A Leakage of Revenue.

IN these times there is the utmost necessity for the managements of gas-works of every size to look into the question of their standards of working in all directions, and not content themselves with leaving the final judgment as to working to the quantity of gas made per ton of coal and to its quality. This is good up to a point; but if it is the *summa summarum* of good working, we are afraid that, in these times of high-priced coal, the chance of gas consumers obtaining further reductions of prices, and shareholders increased dividends, is a trifle obscure and remote, and our competitors who are raising their efficiencies both in the generating station and in the appliances they offer

for domestic, industrial, and street use will, in those places where the price of gas to-day is not what we call "low," gain an advantage. Gauged by their residuals accounts, it is highly questionable whether all gas managements realize that the residuals stand to-day as a defence to the current prices of gas; and it is also questionable, judged by the same means, whether the fullest consideration is given in all cases to procuring the maximum return from the secondary products. More than once we have drawn attention to the curious revelations of the ammoniacal liquor and sulphate of ammonia returns in the accounts of gas concerns, and have pointed to the evidence of the gross waste that takes place in some works. Only recently, prominent attention was called in these columns to the matter in connection with the deplorable waste of ammoniacal liquor that the Inspectors under the Alkali Works Regulation Acts find proceeding in small gas undertakings; and this reference has prompted Mr. Norton H. Humphrys to underline, in an article the first part of which appears this week, the truth of an unpleasant waste that occurs not only in small works, but in larger ones, by inattention to details. This inattention means nothing less than the squandering of good money that might beneficially add to the revenue of a gas-works in these days when the profits per ton of coal carbonized are, at current prices, greatly depreciated by enhanced outgoings.

No gas-works can afford to allow this sort of thing to go on; and there is likelihood that some managements will rue the days of neglect or the days when they turned a deaf ear to such warnings as have been given from time to time. If Mr. W. S. Curphey and his District Inspectors are surprised at the waste of ammonia that goes on in small works by dealing with the liquor as merely an inconvenient something to be got rid of by the most expedient route without gain, they would, as Mr. Humphrys points out, be even more amazed could they investigate the processes of some gas-works, with pretensions to scientific management, and see the waste of ammonia that proceeds in connection with the washers, scrubbers, storage, and other methods of dealing with the liquor. And all this waste, which obtrudes itself upon one from the very face of the works' accounts, is due entirely to lax management, or, in other words, to want of care and skill in supervision. No one expects to get, under the existing systems of high-temperature carbonization, by a considerable proportion, the whole of the ammonia represented by the nitrogen content of the coal carbonized. But when one sees makes of sulphate of ammonia down to 14 to 20 lbs. per ton of coal with a nitrogen content equivalent to that of the coal employed in other works where there is realized approximately a production of 30 lbs. of sulphate per ton of coal carbonized, it causes one to pause and think. Sometimes, as our contributor says, less than 10 per cent. of the total nitrogen in the coal finds its way into the sulphate-store. If it were possible for the other 90 per cent. of the nitrogen to be brought to book in the form of sulphate of ammonia, it would pay the whole of the coal bill at present market prices. This raises a vision which will not materialize. But we see a source of revenue that in many undertakings has been poorly developed; and it is the business—and the immediate business—of the managements to rescue from this source as large a profit as possible. It is Mr. Humphrys' belief, and we share it, that it would pay, and that quickly, many gas-works to have recourse to skilled investigation and advice in this matter of securing the ultimate yield of sulphate of ammonia per ton of coal carbonized. As much as possible must be gained from outside the gas revenue towards paying the coal bill. But—the pity of it—equivalent of hard cash is being allowed to leak away hour by hour in many large gas-works; and the article in other columns shows some of the sources of leakage.

Lessons of London Fires.

THE annual report of the London Fire Brigade always contains its lessons for the suppliers of light, heat, and power, and for the public generally. The tabular statements appended to the report for 1912 again testify to the safety of the use of gas for the purposes named, considered either from the relative numerical point of view, or how far gas *per se* was responsible for producing the mishaps. We all know that, if only care is exercised, there need not be, practically speaking, one fire caused by gas—negligence being almost invariably the sole cause. But it is a gratification to see that the chief officer of the Fire Brigade is able to report figures which show conclusively, despite the larger number of gas consumers in the Metropolitan area, that there has been a substantial diminution in the number of fires in which gas has had any part.

Of fires caused by gas escapes in 1911, there were 113; in 1912, there was a reduction to 95. There need not have been the 95 fires if only there had been care to not allow the escapes of gas to go unheeded. It is also shown that curtains, decorations, &c., coming in contact with gaslight, while responsible for 117 fires in 1911, stand accountable for only 77 in 1912; and gas-stoves, while standing charged with 20 fires in 1911, have only 5 against them for last year, notwithstanding an ever-increasing connection. These figures show a decrease from 250 to 177 fires. This is a healthy movement. But in the case of electricity, fires caused by defective electric circuits increased from 156 in 1911 to 163 in 1912. This is a movement in the wrong direction. In the matter of defective electric circuits, the tenants of dwelling-houses, business or other premises are in no wise to blame for the fires so generated; for neither the sense of smell nor that of sight can prevent these troubles in electric-wiring systems, nor can all the carefully prepared official regulations, which so many responsible electrical men violate. However, the reductions referred to in the case of gas are very satisfactory. Searching carefully through the lists, the total number of fires in which gas is mentioned in any way, or in which it was directly or indirectly responsible for fire, was 286; while in the case of electricity, the total is 170. In the summary of causes of fires, 267 have "cause unknown" entered up against them. If a proper account could be made of the fires in which neglect was responsible for the trouble, there would be few fires for which gas could be truly indicted. It is noticed that only eight fires occurred through that old piece of idiocy, seeking for an escape of gas with a light. Among the misdemeanours of electricity, it is observed that there was one electric iron that caused a fire through getting over-heated; there was also an electric radiator that did the same thing; and an "electric stove" is also similarly charged. An electric radiator that got sufficiently hot to cause a fire, ought to be preserved as a curiosity. Anyway those wits who assert that they have sat on electric radiators when in use without being aware of the fact ought after this event to exercise some care.

For interest's sake, comparison may be made of the proportion of fires to consumers. In the Metropolitan area and around, there are some twenty-eight electricity supply undertakings, and these last year had about 135,000 consumers connected to their cables. The 170 fires therefore average out to 1 per 795 consumers. The three London Gas Companies, in a smaller area than the aggregate districts of the electricity supply concerns, had 1,220,397 consumers; and this gives an average of one gas-caused fire of whatsoever kind to every 4267 consumers. If the number of gas consumers had been taken in the area coterminous with the area within which the London Fire Brigade operates, or the number of gas consumers in the area coinciding with the outer confines of the whole twenty-eight electricity supply undertakings, the average number of gas consumers per gas-generated fire would have appreciably increased. As it is, the "safety" of gas is shown to far outstrip electricity, the mysterious and alarming ways of which in producing fire in the most unexpected places encourage misgivings, while in the case of gas it is often acknowledged that prudence in taking heed of warning would have avoided an unpleasant occurrence.

Economy in Scrapping.

It is not always an economic proceeding to scrap old plant in order to adopt new from which greater economy in working can be achieved. But when the cost of working the new plant is so much below that of the old plant, and the productive results are so much in excess that the profit to be derived more than counterbalances the charges involved in making the change, then it is good policy to discard old plant for new. The reports that have appeared in our columns in regard to the new carbonizing plant schemes for Widnes and Ossett will cause attention to be again directed to this subject; and many engineers may exercise themselves—in consequence of what Mr. Isaac Carr and Mr. A. E. Mottram report—in finding out whether there is financial gain for them in substituting their existing carbonizing plant by something of a newer character. There is a difference between the Widnes and the Ossett reports. Mr. Carr conclusively arrived at the opinion that there would be economy in making a change; and

then he compared the various modern retort systems with a view to selection—determining upon large horizontal retorts, heavy charges, and modern power machinery. The reports that have been published regarding the proposed change at Ossett treat the matter in a different way; the main point being: What are the financial gains to be effected upon the present plant by its substitution by the Dessau system? In both cases, there is going to be substantial economy and profit resulting from the scrapping of the old plant and the adoption of new. From a statement in our news columns to-day regarding the financial aspects of the Ossett scheme, it will be seen that, placing the estimated credits against the debits, there is, compared with the working of the present plant, a balance of £1567 in favour of vertical retorts, to which has to be added a saving in cartage. This being so, it is computed that the economies "will leave a surplus even after the yearly capital charges in the shape of interest and sinking fund on the £26,000 [the total cost of the new scheme] are paid." This is highly satisfactory; and, in the circumstances, Ossett cannot afford to continue under their old system of working, any more than the gas industry can afford to foster flat-flame lighting, and ignore the latest developments of incandescent gas lighting.

Gas Investments.

Once more good service has been rendered to the general public by our contemporary the "Investor's Chronicle," by calling attention to the advantages from an investment point of view possessed by certain representative gas undertakings. And perhaps on the present occasion this service deserves special recognition, bearing in mind the enormous losses in capital value that have been sustained by investors in some other directions. It is true that only five concerns are specifically referred to in the article before us; but the excellent points to be gleaned from the accounts of these will not be sought in vain in the financial statements of a large number of other well-administered gas companies. The concluding sentence is, in fact, intended to apply to a far larger field than the concerns mentioned by name; for the writer says: "A point to note in connection with the many economies which the leading gas companies are successfully practising, to recoup themselves for the abnormally high cost of coal, is that these economies will mean additional profits when this temporarily adverse factor calls for less consideration." The five companies whose attractions for the investor are specially set out are the Gaslight and Coke, the South Metropolitan, the Commercial, the Tottenham and Edmonton, and the Brentford; and in each case the excellent yields at current prices are indicated. These yields and those afforded by many other undertakings both at home and abroad are shown weekly in our own "Gas Companies' Stock and Share List," a casual glance at which, along with a remembrance of many recent happenings, will convince one how easy it is for the investor to go farther and fare much worse.

Engineering and Consultation.

A plea has been made, through an article in "The Times," for a larger reference of work to the consulting engineer, whose services are in danger of being considerably neglected through what is termed the increased "smattering of engineering knowledge" now possessed by those in charge of manufacturing establishments. The writer of the article is not, of course, alluding to extensive works where thoroughly trained engineers are in charge. All the same, the engineering knowledge of those in charge of works of smaller dimensions may surely to-day, in the majority of cases, receive a higher description than that of being a mere "smattering." The champions of the consultant will not do their cause any good by belittling too much the engineering status and competence of those who have so much voice in the bringing about of commissions for consulting engineers. Time brings its greater experience and practice to every man working in a particular line; and if it can be generally said that the engineer in charge of a works is not a better technically educated man than his predecessors, then there is ground for finding fault with the technical educational systems and methods of training that time and experience have established. The process of improvement in all grades of official engineers must be a constant one under the conditions of to-day; and this process must cut, in more or less degree, into the position hitherto held by the consulting engineer. With this qualification, there is much in the "plea" that is good, and which can be supported. Not all official engineers possess the theoretical and practical knowledge necessary to a proper determination as to design, and as to the carrying out of large expenditure schemes, nor the knowledge that is essential, among manufacturers and contractors in these competitive days, to thoroughly safeguard the interests confided to them. Manufacturers of good position and reputation have themselves often to "suffer injustice in having to compete on the strength of crude specifications against inferior competitors who are, of course, able to quote lower prices." Both from the buyers' and the manufacturers' side, there are, where fully qualified engineers are not in charge of works, excellent reasons for consulting an engineer whose theoretical and practical knowledge and experience give him the right to recognition as an engineering specialist.

The Choice of a Consultant.

Then comes the trouble of the man who desires the services of a consulting engineer. He has in the ordinary way to make choice from a crowd. In an industry such as that of gas manufacture and supply, the difficulty is not a burdensome one; for the gas consulting engineers are not numerically great, and reputations are well known. But, speaking generally, as the article points out, there are those who profess and call themselves consulting engineers who are not qualified by practical experience and technical education to act in that capacity. There are men established as consultants who have never been in charge of a works at any time in their professional careers, or who have never received any training on the practical side within the walls of a works. Men who have not had such practical experience are to be avoided as consultants. There are consultants, too, who are interested in manufacturing and contracting firms. In anything relating to the special line of work of such firms, the advice is that such consulting engineers should be avoided; for the suspicion of bias would be there, whether justified or not. Again, "some consulting engineers may be excellent on the practical side, and others on the theoretical; but without a combination of both qualities, it is impossible to advise wisely." That is true. But this all shows how difficult it is for the would-be client to make a proper selection, unless the consulting engineer be a man of high reputation. Never, however, consult a man who has not had practical experience on a works, is pretty good advice, nor a man without good constructional experience; for in the history of his work lies the testimony to capacity. In some important lines of work, it is wise to have the services of a consultant who has specialized in it. Those who have so specialized deserve to be encouraged and to be successful; for "a thorough knowledge in one of the many branches of engineering is much more useful and commendable than a smattering of many." There is much in "The Times" article with which we agree; there is a little one-sidedness about it with which we disagree. There is, however, no difficulty in being in full accord with the concluding words of the article: "The task of a consulting engineer is not by any means an easy one. The proper preparation of a specification in itself requires knowledge beyond the ordinary, as it is essential that the writer should have an intimate acquaintance with workshop practice in addition to thorough theoretical knowledge. Above all, he must be tactful, businesslike, just to the manufacturer, and beyond the suspicion of partisanship."

Valuation Statistics.

A further rise marks the figures which are given in Part I. of the Annual Local Taxation Returns for the year 1911-12. During this period, it appears, the total gross estimated rental for England and Wales (including the gross value in London) increased from £272,249,125 to £275,495,953; this representing a rise of 1·2 per cent. The rateable value at the same time increased from £218,588,250 to £221,011,832, or 1·1 per cent. In the case of London, the increases are only very slight—0·2 per cent. in the gross and 0·4 per cent. in the rateable value. The steady increase witnessed within the last few years in the value of agricultural land, it is gratifying to note, still continues. Between 1908 and 1912, the increase for England and Wales in the gross value (or gross estimated rental) of property was nearly £12,500,000, and the increase in rateable value was more than £8,250,000, of which £7,250,000 represents the increase in urban areas and £1,000,000 that in rural areas—without allowance for alteration of areas. The gross value of property in London increased during the same period by more than £600,000; while the rate-

able value showed a net rise of nearly £340,000. The percentage of increase in the gross value (or gross estimated rental) for the period mentioned for England and Wales was 4·7; and in the case of the rateable value the increase was 3·9. In London, the corresponding figures were respectively 1·1 and 0·8. Comparing the valuation that was in force in 1912 with that of 1897, a net decrease of 1·9 per cent. is seen in the rateable value of agricultural land; whereas in the case of other hereditaments (excluding the annual value upon which Government contributions were made) the rateable value increased to the extent of 36·2 per cent. The total rateable value of the rateable hereditaments in England and Wales (exclusive of the annual value upon which contributions in lieu of rates were made by the Government) increased by 30·7 per cent. during the same period.

Lighting of Schools.

The investigation on the subject of the lighting of schools that Dr. Cameron Gibson has made for the Education Department of the Cheshire County Council is of interest; but we should have been pleased if the report on the subject had gone further, and had been more pronounced as to the deductions to be drawn. The tabulated figures that he gives show conclusively that both batswing burners and upright incandescent gas-burners ought to be discarded in schoolroom lighting. Indeed, we cannot understand any school authority retaining luminous flames for lighting their schoolrooms. As to the upright incandescent burners, in most cases the ratio of maximum to minimum illumination in foot-candles is of a character that should cause their displacement by inverted gas-burners. Besides good illumination, economical lighting is, as the figures indicate, to be obtained by the change. If it is possible for Dr. Meredith Young to now supplement Dr. Gibson's report to the Education Department of the Cheshire County Council, he will find some suggestive statements in the report of the proceedings at the recent International Medical Conference regarding the effect of electric lamps—lamps of much higher intrinsic brilliancy than incandescent gas-burners—on the eyesight of children.

Business in Australia.

It was natural that the first remarks of the Chairman at the recent meeting of the Australian Gaslight Company (a report of the proceedings at which appears elsewhere in this issue) should have reference to the ill-advised and unjustifiable action of the employees in going out on strike in the early part of this year—by which action so much temporary inconvenience was caused both to consumers and to those who were responsible for the carrying on of the business. However, this big trouble is over, matters having been arranged on terms already notified; and so a glance may now be given at the brighter side of things. The statements made at the meeting afford ample room for cheerfulness, when regarding both the present and the future of the undertaking. Business has been growing rapidly, along with the general commercial prosperity of Sydney; the consumption of gas in the twelve months to June last having been no less than 40 per cent. above that of 1909. The day consumption, too, represents over 50 per cent. of the total sales. The Company have sold a total of over 31,000 gas-cookers, and the number of consumers goes on increasing merrily. There is electric competition, it is true; but it is competition that the Company are clearly thoroughly well able to hold their own—and more than hold their own—against.

National Free Labour Association.

The dead-set that is just now being made in various directions against the employment of non-unionist labour is a serious thing both for this free labour and for employers. The question is an old one; and it is easy to understand the anxiety of the union leaders to get all within the fold. At the same time, however, it is equally easy to see the importance from the point of view of the other parties—free labour and capital—of opposing a coercive policy in this respect. The employers fortunately have their own Associations to assist them in different ways; and the men themselves have a mouthpiece—and what has on many occasions proved a powerful fighting machine—in the shape of the National Free Labour Association, who will be holding their twenty-first annual congress in London next month. At this gathering it is certain that ample advantage will be taken of the opportunity of drawing attention to the aims of organized labour as represented by the trades unions. But other matters will also be submitted for consideration. The non-unionist has learnt from experience just what meaning to attach to "peaceful persuasion" as practised by pickets during strikes, &c.; and a large measure of support may therefore be expected for a resolution which calls for a repeal of the Trade Disputes Act. Other resolutions are calculated to bring into the limelight the trade unionist proclivities of the Board of Trade and the Government generally. The reasonableness of having a Free Labour Congress as well as a Trades Union Congress cannot be denied, in face of the assertion that the male wage-earning population of the country is 15 millions, while less than 3 million of these men are in the unions. The remaining 12 millions are clearly entitled to make themselves at least equally well heard—if they can.

Frankfort-on-Main Gas Exhibition.

We learn from the "Journal für Gasbeleuchtung" of Aug. 30 that the gas exhibition in Frankfort, which has aroused widespread interest and received generous support from all parts of Germany, was formally opened on Aug. 23, in the exhibition halls in the Ostendstrasse, by the Chief Burgomaster of Frankfort. Special mention is made of the educational nature of the exhibition, in which apparatus of all kinds and for every application of gas can be seen in actual working. Popular lectures are given on cooking and baking, illustrated practically. Model gas kitchens, ironing rooms, and illuminated shop-windows are all to be seen, as well as dwellings for all social classes, bathrooms, &c., all completely fitted with gas. Lighting installations for halls and streets are also shown. The exhibition, which remains open till the 7th inst., is recommended as highly instructive to all grades of the gas industry, from managers and engineers to foremen and fitters.

Presentations to Mr. Horace Chamberlain.

As already announced in the "Journal," Mr. Horace Chamberlain, the Assistant Engineer and Manager at the Hull station of the British Gaslight Company, has been appointed Gas Engineer and Manager to the Workington Corporation, in succession to Mr. E. G. Hutchinson. He bade farewell to his numerous friends at Hull last Thursday, when he received tokens of the esteem in which he is held by them. The officials presented him with a pair of silver candelabra; the officials and employees at Sculcoates with a Coalport china dessert service; and the Cricket Club, in which he has always manifested great interest, with an autograph album. The presentations were made in the dining-hall at the Sculcoates works. Mr. John Young, the Engineer and Manager, in asking Mr. Chamberlain's acceptance of the dessert service and the candelabra, alluded to the good feeling which existed between the officials and workmen, and paid a warm tribute to Mr. Chamberlain's services. He wished him health, happiness, and success, and remarked that, in business, sport, and social work, pleasant relations had long existed between Mr. Chamberlain and other officials. The recipient, in returning thanks, said he admired the spirit in which the presentation had been made. He took it as a great compliment that the gift had come from all his old friends, who had acted on their own initiative. One could not leave friends of nine years' standing without regret; and in the future he would remember their good wishes. Mr. Lovatt expressed the hope that Mr. Chamberlain's appointment would be a stepping-stone to something higher. Mr. Allan remarked that Mr. Chamberlain was the ninth person who had gone from the Hull station of the British Gaslight Company to another part of the country. All had, he said, done well in their new appointments; and this spoke highly for Hull. Mr. Chamberlain replied in suitable terms for the gifts from the officials and members of the Cricket Club, of which he was the first Chairman. Votes of thanks were accorded to Mr. Young and the officials.

Fixing Globes of Inverted Gas-Burners.—A patent has been granted to Mr. P. S. Bridgeford for an invention for facilitating the fixing of globes of inverted gas-burners and other forms of lighting. In place of the usual screws, there are three catches, which are operated simultaneously by a ring—a slight movement to the right attaching the globe, and a similar movement to the left detaching it. The device should be a convenience to the users of inverted gas-burners; as it will save much time in replacing the mantles and cleaning the globes in establishments where many burners are employed.

Russia's Wealth of Coal.—At a congress held in St. Petersburg for mining, metallurgy, &c., some information was given about Russia's wealth of coal, based upon calculations undertaken by the Geological Committee. The aggregate of European Russia's coal deposits was put at 75,000 million tons, and that of Asiatic Russia at about 175,000 million tons. As regards the quality, it was stated that the Donetz Basin is the only locality which supplies Russian metallurgical coke. In future there is reason to believe that the Kusulgk Basin will also supply this coke for Western Siberia. A further careful investigation of Russia's, and more especially Siberia's, coal deposits was urgently recommended.

OBITUARY.

By the death, which occurred suddenly on the 24th ult., of Mr. FREDERICK BEARDSLEY, Ilkeston has lost one of its best-known public men; he having been an ex-Mayor and Alderman of the borough, and for nearly twenty-two years Chairman of the Gas Committee. Deceased, who was a lace manufacturer, was in his seventy-fifth year; and the illness to which he eventually succumbed is regarded as being traceable to a chill which he contracted when he ventured out on a snowy night to visit the scene of the gasholder disaster early last year. The late Mr. Beardsley was one of the first representatives returned to the Corporation after Ilkeston's creation as a municipal centre; and he continued to sit as alderman until his retirement a month ago. The large attendance at the funeral, which took place last Wednesday, was evidence of the high esteem in which his services were held.

PERSONAL.

In response to the advertisement which appeared in the "JOURNAL" a few weeks ago, Mr. THOMAS WILKINSON, Assistant at the Bingley Gas-Works, has been appointed, out of nearly a hundred applicants, Manager to the Abercarn District Council, and will take up his new duties next month.

It was mentioned in the "JOURNAL" last week that Mr. W. C. JONES, the Manager of the Brierley Hill District Gas Company, had sufficiently recovered from his severe accident to allow of his removal from the Corbett Hospital to his home. His many friends will be pleased to learn that he is now able to get about again, and hopes to go away very soon for a change.

Consequent upon the removal of Mr. Horace Chamberlain to Workington, Mr. JOHN YOUNG, jun., has been appointed Assistant Engineer and Manager at the Hull station of the British Gaslight Company. He was trained at the Sculcoates works and also at Bournemouth, and has had considerable experience in erection work for Messrs. R. & J. Dempster and Messrs. Duckham and Cloudsley.

The employees of the Tipperary Gas Company have presented Mr. WALTER E. YOUNG, the Manager, with a marble clock, as a token of their esteem on his transfer to the Queenstown Gas-Works. Other friends have also honoured Mr. Young by presenting him with an escritoire. In reply to the Company's employees, Mr. Young said that, as an Englishman, he would never forget the courtesy and kindness extended to him by all classes in Tipperary.

Mr. G. H. ELLIOTT, an Assistant to Mr. John Young at the Hull station of the British Gaslight Company, has been appointed Assistant to Mr. George Helps, the Engineer and Manager of the Nuneaton Gas Company. He received his training at the Sculcoates works and at the Hull Technical School. He has been at the Hull station for thirteen years, during which period he gained extensive experience. He is succeeded by Mr. C. T. ATKIN, who has been entirely trained at this station.

Mr. HERBERT S. PIKE, the Engineer and Manager of the Colchester Gas Company, has resigned his position, and is now retiring from the profession. He had a very serious illness last spring, from which he has never thoroughly recovered; and he feels that a long rest is absolutely necessary. Mr. Pike has been with the Colchester Gas Company for the past twenty-five years. The Directors expressed much regret at having to accept Mr. Pike's resignation, and unanimously thanked him for past valuable and faithful services to the Company—a resolution in regard to which was duly entered on their minutes.

An interesting ceremony took place at the Dartford Gas-Works last Tuesday, when the Assistant Engineer and Manager, Mr. C. VALON BENNETT (who, as already announced, is leaving Dartford to take up his new duties as Chief Engineer to the Rochester, Chatham, and Gillingham Gas Company), was presented by the employees with a handsome marble clock, and a cigarette-holder in a silver case. The Inspector (Mr. James) was requested by the workmen to make the presentation. In the course of his speech, he expressed the regret of all that Mr. Bennett was leaving them, but said they wished him success and happiness in his new sphere. Mr. Bennett suitably replied, and asked the men to give the support to his successor (Mr. Bernard P. Bezant) that they had given to him during the past three-and-a-half years.

The Gas-Meter Company.—We are asked by the Board of the Company to publish the following: "As announced in last week's issue, Mr. Thomas Wilkins has retired from the position of Manager of the Gas-Meter Company, in consequence of advancing years. The Directors had pleasure in recognizing his long and faithful services by an adequate retiring allowance. To succeed him they have appointed Mr. F. G. Cockey, an engineer of considerable experience, formerly a member of the well-known firm at Frome. He will have supervision of the manufacture of the meters and all goods the Company supply, with charge of all technical matters; and Mr. F. W. Church, the Secretary, will control the general administration, the correspondence, and the Company's financial business."

ELECTRICITY SUPPLY MEMORANDA.

The Half-Watt Lamp.

In consequence of the alarm in large parts of the electrical realm over the prematurely announced advent of the half-watt lamp, Messrs. Siemens Bros. (who have been very prominent of late in publishing lamp intelligence) have found it necessary to write a letter to the Press to allay the perturbation, and to give encouragement by assuring those who read their communication that the new wire lamp, being a large power unit and economical, is really going to do the trick in the competition with high-pressure gas-lamps. This is what Siemens Bros. write to our electrical contemporaries:

> In order to correct certain erroneous rumours which have been circulated during the past few weeks on the subject of the new "half-watt" lamp, we shall be glad if you will inform your readers that the lamp in question will, at any rate, for some considerable time to come, only be supplied in units of extremely high candle power to compete with high-pressure gas "arcs" for street lighting, &c., and, of course, electric arc lamps. It is probable that such "half-watt" lamps will be available in commercial quantities during the present year; and we hope before long to have an opportunity of demonstrating the lamp to members of the Press. The new lamp is of particular interest, as it embodies certain novel processes of manufacture not hitherto applied to electric lamps.

Of course, they are to compete with electric arc lamps! Poor electric arc lamps, they have been having a lazy commercial existence lately. What with the high-pressure gas-lamp dethroning them by the hundreds in large shopping centres, and the metallic filament lamp displacing them elsewhere, they have been badly injured. But as to the new lamp competing with high-pressure gas-lamps, the modern electric arc is more economical in energy than will be the new metallic filament lamp; yet high-pressure gas-lamps have evicted electric arcs. Respecting the statement that the new lamp embodies certain novel features, the "Electrical Times" believes that one of the features is concerned with the presence in the lamp of an inert gas under pressure, while it will probably be found that the leading-in arrangements have also been simplified. The life of the lamp, it is stated, is likely to be 1000 hours. What will be the price?

Ridiculously Low Rates.

All in the electricity supply industry are not tarred with the same brush. There are among its technical advisers and officers those who are decidedly in opposition to the stupid lengths to which certain officials have gone, through the indulgence of either lethargic or dull-witted committeemen, in their tariffs for such demands as heating and cooking. We have referred recently to the criticism of Mr. E. T. Ruthven Murray and Mr. F. W. Cole; and now a Westminster "Consultant" has written to "Electrical Industries" on the same lines as those gentlemen took. "Consultant" says he has had personal experience of lighting consumers, through hearing of the low rates for cooking and heating, getting hold of the idea that their lighting rates are monstrously unfair and exorbitant, with the result that the position in which the central station engineer finds himself is not being increased in comfort. He therefore condemns the booming of ridiculously low rates. Like others, he points to the fact that gas undertakings "created the habit" of gas cooking and heating on the flat-rates charged for lighting. If there is so much virtue in electric cooking and heating, then surely it should be an easy thing for the electrical people to get better prices for the current. The statement is that electric cooking and electric heating have the maximum of virtues; but the statement is discounted by the offers of current going begging at ¾d. and ½d. per unit. "Consultant" also alludes to Mr. J. Horace Bowden's ideal for the future (this also was recently noticed in our "Memoranda") of a fixed charge for electricity just the same as the fixed water-rate. "Consultant" is sure that the ideal will never materialize "this side of Kingdom Come."

Quadruped Electric-Cookers.

The electrical people have again discovered a disadvantage in gas-ovens, and an advantage in the few electric-ovens that have been constructed with legs to raise them from the floor. The electric-oven manufacturers who have made this wonderful discovery as to the raising of electric-ovens on legs are patted on the backs for their ingenuity. They are—we are sorry to detract from their glory—merely the slavish imitators of a design of which most gas-oven makers have long had patterns. In introducing the quadruped electric-cookers, it is interesting to read of the, from the electrical point of view, disadvantages of the ordinary legless form of gas-cooker. One of the drawbacks is said to be that, the gas-oven being placed on the floor, it is necessary to stoop right down and examine the food; and so users have been forced to adapt themselves to an inconvenient and needless position. We thought the bipeds who thankfully changed from the low-situated coal-heated oven to the gas-heated one had about got accustomed to the employment of the bending power with which Nature had thoughtfully endowed them. The abuse heaped on the popular gas-oven since the electrical people started their campaign has shown their remarkable development of imagination, and more than a trace of something

that is the very opposite of righteousness. We find that the experience of this electrical writer is that the position of the oven also assists in accumulating dirt, fluff, grease, and other undesirable objects. We are not accustomed in our own household to the slatternly ways of which that writer has apparently had experience. The reason the ill-informed electrician attributes for placing the gas-cooker on the floor is that the oven must be much deeper than is really necessary for cooking on account of the exposed flames below. Not a bit of it. The ovens on legs disprove the assertion. But the richest piece of fabrication is that it is only the upper portion of a gas-oven that can be used—the gas-flames below making it impossible for anything to exist unburned in their immediate vicinity. Many little kitchen maids would, if they heard this pitiful nonsense, like to use an uncomplimentary expression of four letters within the hearing of the author. Day by day in hundreds of thousands of households, the full depth of gas-ovens is being used in the preparation of dinners. Can anyone show us an electric-cooker occupying the same space as a gas-oven with top-plate, inside the oven of which electric-cooker and on the top plate an amount of work equal to the ability of the gas-cooker can be done in the same time. That is where the electrical shoe pinches. There is found the cause of all this small talk and writing on the part of the advocates of the electric-oven.

Oven Lamps.

Among the fittings of electric ovens requisite for rescuing something from their uneconomy are thermometers and lamps —both being provided in order to keep control over the oven and the cooking without opening the oven-door for inspection purposes, and so allowing heat to escape. Means of cooking that require so much carefulness will not make great headway in popularity. But it is questionable whether both thermometers and lamps are really useful adjuncts. The thermometer bulb, for instance, is placed inside the oven, but the long stem of the thermometer is run outside, and is subject to room temperature and draughts. How, under such circumstances, it can give a proper reading of the oven temperature at all seasons of the year is beyond comprehension. As to the inside hung lamp for examining (through a glass pane in the oven door) the food undergoing cooking, it is absolutely useless, as both it and the glass in the door get steamed and greasy, and so rendered practically opaque. The point as to the life of lamps placed in ovens has been raised, by a baker complaining that the lamps he has had in use in his oven have quickly departed this life—in fact, in ten to fourteen days. There was a little ridicule poured upon his complaint; but others who have had experience have confirmed that of the baker. Mr. J. W. Beauchamp, of West Ham, finds that high external temperature considerably shortens the lives of electric incandescent lamps. He has experimented with some carbon lamps with thick glass bulbs; but these, too, have not proved to be entirely satisfactory. Mr. Beauchamp therefore recommends that ovens should have windows in them with lamps suspended outside. Another correspondent believes the breakdown of the lamps is due to the failure of the vacuum; but he is not clear as to the way the failure is brought about.

Fire Risks.

An article appeared in "The Times" recently which was directed to showing how much better they do things in America than in this country in, as far as possible, protecting the public from trouble with apparatus in which fire risk is involved—such as electrical apparatus. The National Board of Fire Underwriters have standard regulations which are generally recognized; and to see that the regulations are complied with in the case of apparatus, there has been established in Chicago, since 1901, the Underwriters' Laboratory, at which manufacturers can have their appliances examined and certified as complying with the regulations. People prefer this, with such subtle trouble-creating appliances as those in which the heating is by electrical energy. The conditions in this country are the reverse. There are electrical regulations by the Home Office, the Board of Trade, the Fire Offices, the Institution of Electrical Engineers, and certain municipalities; and there is no one to enforce the carrying out of the regulations in private places. The result of this sort of thing is that an Arbitrator finds that work carried out by the Marylebone Electricity Department does not comply with the regulations of the Institution of Electrical Engineers [*ante*, p. 549]. In the case of collieries the Home Office finds it necessary to summon owners for discovered breaches of Departmental regulations. But with all the standardization of regulation and examination in America, in the very city in which the Underwriters' Laboratory is situated, trouble is experienced from electrical causes. From an electrical paper, we extract the following paragraph:

> During 1912 there were 71 fires in Chicago certified as being due to electrical causes. The damage is estimated at about £6300. It appears that eleven were due to the short-circuiting of low-pressure cables, six to motor armature burn-outs, six to flat-irons left on circuit, five to flexible cords short-circuiting (the most serious fire was due to this cause), four to short-circuits on conduit, three to ignition of cinematograph films, three to inflammable material about incandescent lamps, and the remainder to miscellaneous causes.

This looks bad; but it is the same the world over where there is electricity supply. In our editorial columns to-day, some statistics are published from the London Fire Brigade report, which show that during 1912 there were a considerable number of fires due to fusings. This does not take into account those smaller, but still alarming, ones which occur, and do not come within the Brigade's cognizance.

The Old Story.

The original "initial" estimate for the electricity supply scheme for Aylesbury was £17,878. It has gone up to £21,283! And people are asking now what is likely to be the final "initial" outlay. The scheme on which the referendum to the ratepayers took place represented the lower figured scheme. There has been no referendum on the £21,283 scheme. This is the customary way in matters electrical; so that this Aylesbury incident creates no surprise.

The Long-Deferred Reply.

As far back as July 8, a criticism appeared in the "Memoranda" of a pamphlet distributed in the Bexley district by Mr. H. P. Stokes, the Engineer and Manager of the District Council's Electricity Department. No reply to that criticism reaching us from Mr. Stokes, it was considered that a personal communication to that gentleman might induce him to attempt to "make good" in our columns the points upon which comment had been made, and some of which points were, in our estimation, of an offensive and really slanderous order to the gas industry, and particularly to the gas undertaking with which the Bexley District Council are competing with their electricity, and which undertaking is among the largest of the ratepayers of the Council. Our letter was addressed to Mr. Stokes on the 16th of July; and it concluded with the pious wish that he should deal with our criticisms, and in a frank manner. On July 18, Mr. Stokes wrote. After thanking us for our letter, he said: "Although I am not in the habit of opening up correspondence with any form of journal, as you have written to me personally with regard to the matter, I will endeavour to let you have a communication during the ensuing week. I am afraid I cannot let you have this in time for publishing next week. I rather like your hint at the end of the 'paragraph,' and would suggest that you also profit by the same remark." Up to the time of going to press yesterday—Sept. 1—no communication, frank or otherwise, had been received from Mr. Stokes in accordance with his promised "endeavour." We still hope.

Dangers of Fire from Incandescent Electric Lamps.

The following remarks on this subject were recently sent to the "Chemical News" by their Paris correspondent: "Concerning the burning of the theatre of Stettin, M. Boje has been requested to examine if the cause of the fire might not be attributed to portable electric lamps. To this intent, he supplied each type of protector with lamps with carbon filaments of 16 candles, 220 volts, and by turns wrapped them in stuffs of cloth, wool, silk, and linen, so as to isolate them as much as possible from the air. In the case of two lamps, the cloth stuff caught fire after 25 minutes' contact with the ampullas, and after 30 minutes without touching the glass. The light woollen, silk, and cotton stuff took fire when in contact with the bulbs at the end of 5 to 15 minutes. The heating was such that the ampulla itself became softened and broke. The two other lamps wrapped in towels caused burns at the end of 30 minutes and 2 hours and 40 minutes. The highest temperature noted was 213° C. One lamp was experimented upon by enclosing it in a box with wooden shavings. These took fire at the end of three hours. This experiment demonstrates clearly that all portable lamps actually in use may become dangerous when they are furnished with ampulla with carbon filaments of 16 candles and 220 volts."

Lighting of Paris.—According to the Paris Correspondent of the "Chemical News," M. Lauriol, the Chief Engineer of the Lighting Service of Paris, has recently published statistics which show that the illuminating power of the appliances used for public lighting amounts to about 7 million candles per 24 hours. The quantity of gas employed in this period for public lighting exceeds 91,600 cubic metres (3,235,000 cubic feet). For the private service, the consumption (lighting and motive power) amounts to 1,140,000 cubic metres (40,261,500 cubic feet). The quantities of electricity employed in 24 hours are 13,000 kilowatts for public, and 154,000 kilowatts for private, lighting. The hours of greatest lighting vary according to the season. It is, however, noticed that the maximum consumption of electricity takes place about six o'clock in winter; of gas, about eight o'clock in summer.

A Naphthalene Locomotive.—According to an article in the Engineering Supplement to "The Times," there has lately been constructed at the Creusot works a locomotive which is driven by naphthalene. Its total length is 19 feet, and its adhesive weight 18 tons. It has four cylinders cast in pairs, with a 5½-inch bore and an 8-inch stroke; and it develops 70 H.P. at 950 revolutions per minute. Two carburettors are employed—one for starting on spirit and the other for running on naphthalene. The latter is in one piece with the reservoir in which the naphthalene is melted—the whole having double walls, between which the cooling water circulates. This water is maintained at 100° C., and thus the melting is carried out at a constant temperature, which would not be the case if the exhaust gases were used for the purpose. The cost of running is about 5c. per horse-power-hour, including the spirit consumed in starting.

GAS-WORKS AND VEGETATION.

Some Interesting Photographs.

A series of recent photographs of the Aberystwyth Gas-Works has been forwarded by Mr. J. Gaunt, the Manager, in refutation of an old and hard-dying, but unjust belief. Some of the photographs we reproduce, together with the following remarks by Mr. Gaunt which accompanied them.

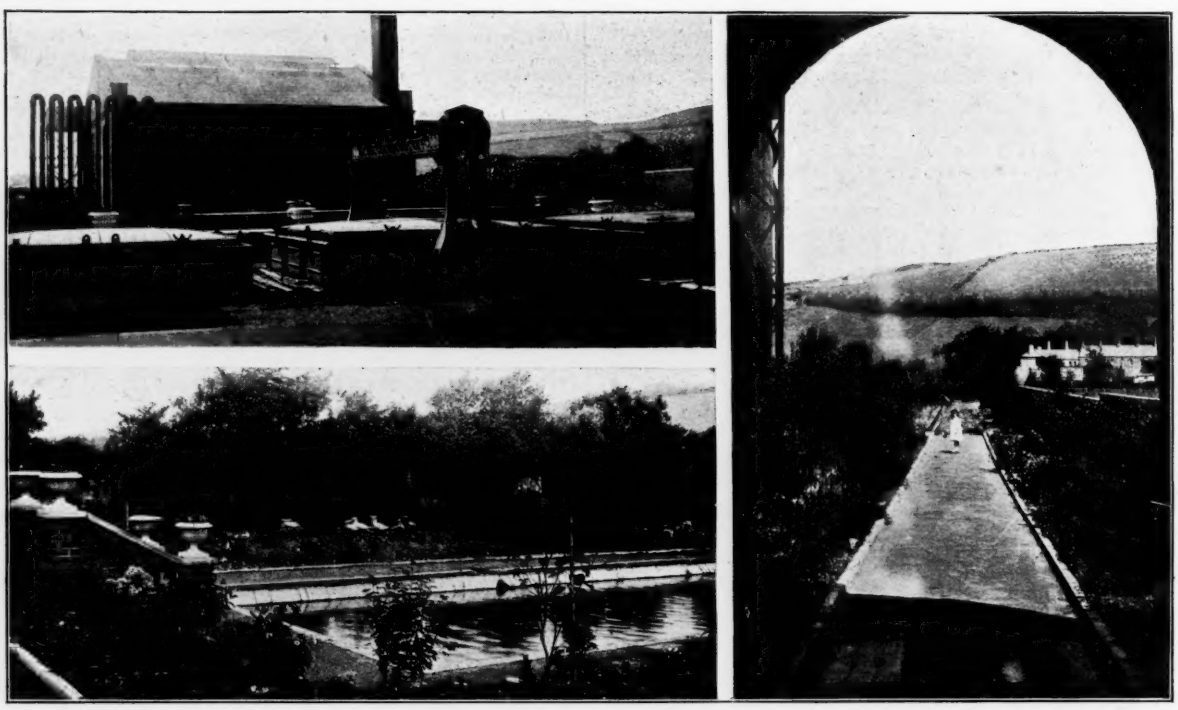
It was, during the erection of these works, rumoured by our neighbours that the fumes from the works would prove detrimental to the fruit growing; and an objection was made on this account. In order to combat this idea, the Directors decided to plant fruit trees on the site; and the result was that after a few years' growth we were able to invite the inhabitants to visit the works and show what fruit could be grown on the gas-works premises, which was convincing proof.

You will note the vases stand upon our tar and ammoniacal liquor tanks; and they are at present quite a picture with their bloom. Owing to the nature of the ground, it was found impossible to sink a tar-well; and a number of old egg-end boilers were purchased and partly sunk in the ground, walled round with 4½-inch brickwork, and covered with concrete slabs, which gave a very pleasing effect.

Further, you will notice our station-meter and governor stand outside in the open. It will be interesting to know if any other works in the British Isles have this apparatus situate outside. Of course, we do not experience severe frosts; but occasionally we have sufficient to freeze the water, which would cause trouble. To get over this difficulty, an old Cornish boiler has been converted into a superheater, using the exhaust steam gathered in a 4-inch main from pumps, engines, &c., and conveyed through a series of tubes surrounded by water, to condense and do away with the nuisance of steam blowing about the works, with the result that we are supplied with ample boiling water for workmen's bath-room, boiler, and anti-freezing purposes.

Should any of our friends happen to be spending their holidays in or near our town, we shall be pleased for them to pay us a visit, when I feel sure we can give them an interesting time.

In the centre of the works is a neatly trimmed lawn; and in the fruit garden behind the holders is a small artificial lake with flower borders.



VIEWS IN AND NEAR THE ABERYSTWYTH GAS-WORKS.

OUTPUT OF COAL IN 1912.

The annual Home Office report on Mines and Quarries is a comprehensive compilation, issued in four separate parts, dealing respectively with district statistics, labour, output, and colonial and foreign statistics. The first part of the series for 1912 has recently appeared, over the signature of Mr. R. A. S. Redmayne, Chief Inspector of Mines; and though more detailed information will be available when the part dealing with output is published later on, a few figures from the district statistics may meanwhile be noted.

During the past year, the total output of coal in the United Kingdom from mines (there was in addition a small amount of 17,760 tons from open quarries) under the Coal Mines Act was 260,398,578 tons, which compares with 271,878,124 tons in 1911. It is, however, pointed out in the report that the actual falling-off in production is somewhat less than these figures indicate, inasmuch as in previous years some owners have been in the habit of returning the gross weight sent out of the pit, including dirt, while on the present occasion they have returned the net output of coal. It is estimated that the amount of dirt which would have been included if the returns had been made in the same way as in previous years is 2,267,789 tons; and thus the actual falling-off in output, including the small quantity obtained from quarries, is 9,207,772 tons. This decrease in output is, of course, accounted for by the miners' strike; and the remark is made in the report that it is much less than might have been anticipated—a state of affairs which is explained by the fact that before the strike the collieries in most of the districts were worked very hard. For purposes of inspection, the United Kingdom is divided into eight districts; and the respective outputs for last year, and the decrease or increase as compared with the preceding twelve months, are as follows. The figures of output include, it should be mentioned, the estimated amount of dirt, in order to furnish a proper comparison with the year 1911. Scotland, 40,032,193 tons, decrease 1,685,970 tons; Newcastle, 28,442,899 tons, decrease 2,348,891 tons; Durham, 25,993,058 tons, decrease 1,916,142 tons; York and North Midland, 65,163,586 tons, decrease 1,816,584 tons; Manchester and Ireland, 10,608,481 tons, decrease 496,961 tons; Liverpool and North Wales, 15,939,777 tons, decrease 462,572 tons; South Wales, 50,267,923 tons, increase 67,196 tons; and Midland and Southern, 26,236,210 tons, decrease 547,848 tons.

There were last year 1,089,090 persons employed at the 3265 mines under the Coal Mines Act; this being an increase of 21,877 persons compared with the previous year. Of the total number, 878,759, or 80·7 per cent., were employed below ground. The average output of mineral at mines under the Coal Mines Act was 311 tons per person employed underground—a decrease of 20 tons on the preceding year. At these mines there were in the past year 1151 separate fatal accidents, causing 1276 deaths. These figures, when compared with 1911, represent a decrease of 61 in the number of accidents, and an increase of 11 in the number of deaths. The death rate from accidents of the underground workers was 1·25 per 1000 persons employed, and that of the underground and surface workers combined was 1·17 per 1000. These percentages are the lowest on record; but in this respect, as when considering the question of output, it is pointed out, the fact of the national strike has to be borne in mind. Had there been no strike, the number of fatal accidents would have been greater, and the death rates also, as they would have been calculated on the same numbers of persons engaged—no allowance having been made on account of the strike in the returns regarding persons employed.

THE RECONSTITUTION OF THE INTERNATIONAL PHOTOMETRIC COMMISSION.

Meeting in Berlin, Aug. 27 to 30.

A MEETING of delegates from the technical gas, electricity, and illuminating institutions of nine different countries was held in Berlin last week, to formulate statutes for an International Commission on Illumination which will continue the work on a wider basis of the International Photometric Commission. The meeting opened on Wednesday, under the chairmanship of Professor Vautier, of Lyons, who has acted as President of the latter Commission throughout the thirteen years of its existence.

A Sub-Committee had been appointed in October, 1912, by Professor Vautier, with the concurrence of the National gas institutions affiliated to the International Photometric Commission, to draft statutes for the enlarged Commission on Illumination into which it was proposed that the Photometric Commission should be merged. The draft statutes provided for the affiliation to the Commission, on equal terms, of both the gas and electrical institutions of each country, and also of bodies such as the illuminating engineering societies in countries where they exist. The representation of each country on the Commission would be through delegates and members of the Executive Committee nominated by a National Committee formed by the technical institutions of the country in question. Provision was also made in the draft statutes for representation on the Commission of countries in which for any reason it had not proved feasible to form a National Committee.

The delegates to the Berlin meeting were engaged throughout the four days in the discussion and amendment of the draft statutes, which, in the revised form in which they were ultimately approved, will be submitted to the Provisional National Committees and the technical institutions for confirmation. After the very full consideration which was given to the statutes by the delegates at Berlin, with the object of meeting the views of each country and of every technical institution directly interested in questions of illumination, it may be anticipated that the statutes as approved at the Berlin meeting will receive the confirmation of the various technical institutions in all the countries represented on the old Photometric Commission. This confirmation necessarily cannot be obtained until the Councils of the various institutions have met; and it is unlikely that it will be regarded as appropriate that the statutes should be made public until after they have been ratified by these institutions.

Great Britain was represented at the Berlin meeting last week by the following delegates: Mr. W. J. Atkinson Butterfield and Dr. Harold G. Colman, representing the Institution of Gas Engineers; Mr. W. Duddell, F.R.S., the President, and Mr. Edgecumbe, a member, of the Institution of Electrical Engineers; Mr. Leon Gaster, Secretary of the Illuminating Engineering Society, and Mr. Le Maistre, Secretary of the International Electrotechnical Commission, representing the former body; and Mr. Clifford C. Paterson, of the National Physical Laboratory.

The United States of America were represented by Dr. Bell, Dr. Hyde, Dr. Kenelly, Mr. Mailloux, Mr. Miller (of Humphreys and Miller), and Dr. Sharp. Austria was represented by Professor H. Strache, of Vienna; and Hungary, by Dr. Kusminsky. Belgium was represented by M. Greyson de Schodt. The French delegates, in addition to the Chairman, M. Vautier, were Dr. Broca, M. Laporte, M. Janet, and M. Massé. Germany was represented by Herr Bloch, Dr. Brodhun, Dr. Karl Bunte, Professor H. Drehschmidt, Professor Eitner, Herr Görges, Dr. H. Krüss, Dr. Mohr, Dr. Monasch, and Professor Weber. The delegates from Holland were Professor A. Feldmann, Dr. M. de Haas, de Heer W. Niermeyer, de Heer J. van Rossum du Chattel, and de Heer L. Terneden. The representatives from Italy were Signor Böhm, Dr. Conti, Dr. Clerici, Signor Sales, and Dr. Vallauri. Switzerland was represented by Herr Filliol, Herr Gerwer, Dr. Ott, and Herr Weiss. It will be seen that the Berlin meeting was thoroughly representative of the gas, electricity, and illumination institutions of all the countries, and included very many men of the highest international reputation. The fact that they have deemed it right to devote so much of their valuable time to the inauguration of the new Commission augurs well for its future career.

The Sub-Committee who had prepared the draft statutes, which were considered and amended at the meeting, consisted of Dr. Brodhun, Professor at the Imperial Physical Technical Institute at Charlottenburg (the Reichsanstalt); Dr. Kusminsky, of the Standards Office at Vienna; M. Laporte, of the Central Electricity Laboratory at Paris; Dr. E. B. Rosa, of the Bureau of Standards at Washington; M. Vautier, of Lyons, President of the International Photometric Commission; and Mr. Clifford C. Paterson, of the National Physical Laboratory, Teddington, who acted as Secretary of the Sub-Committee. The above-named gentlemen deserved, and received, the hearty thanks of the delegates for their prolonged labours in the preparation of the draft statutes.

The sittings of the Commission last week took place in a room in the main building of the Reichsanstalt, at Charlottenburg, kindly placed at their disposal by the authorities of the Institute. On Wednesday, M. Vautier opened the proceedings with an address, in which he reviewed the formation and work of the International Photometric Commission, and the influences and negotiations which had led to the proposed enlargement of its membership and scope which the delegates had met to consider. Then, without more ado, the consideration of the draft statutes was proceeded with. It was decided that the reference text of the statutes should be in French, from which official translations in English and German would be prepared. Towards the close of the meeting on Saturday the revised statutes were approved (subject to ratification by the technical institutions of each country) *en bloc* by the delegates, both individually and as representatives of each country.

The meeting then proceeded to elect officers to act until the close of the next meeting of the Commission, in the event of the statutes, &c., being ratified. The officers elected were: President, M. Vautier (France); Hon. Secretary, Mr. C. C. Paterson (Great Britain); Treasurer, Herr Weiss (Switzerland); Vice-Presidents, Professor Geheimrat H. Bunte (Germany), Dr. Hyde (U.S.A.), and Dr. Kusminsky (Austria-Hungary). According to the new statutes, the three first-named officers will form the bureau or officers of the Commission; and they, together with the three Vice-Presidents and two representatives of each country affiliated to the Commission, will form its Executive Committee. The Hon. Secretary will have the assistance of a General Secretary; and the meeting provisionally named for Mr. Paterson's guidance a maximum of £200 per annum for the salary of the General Secretary, whose appointment by Mr. Paterson will require the confirmation of the other officers of the Commission. Provisionally, also, it was decided that the annual contribution of each affiliated country to the expenses of the Commission should be £50 (to be subscribed by agreement between the various technical institutions concerned in each country. This would cover the salary of the General Secretary, and the establishment of an office in the country of the Secretary for the transaction of the affairs of the Commission.

The delegates at Berlin dined together in the Esplanade Hotel on Thursday evening last, and on Friday evening were entertained at dinner in the Restaurant of the Zoological Gardens by the German Illuminating Engineering Society—a body that was recently formed by the co-operation of prominent members of the German Association of Gas and Water Engineers and of the German Electrotechnical Association with other persons interested in the art of illumination. The statutes were not finally passed, for presentation to the technical institutions of each country, until a late hour on Saturday evening, when the proceedings terminated with a vote of thanks to the Chairman.

The late Mr. Arthur Graham, for many years Manager of the Mansfield Corporation gas and water undertakings, whose death occurred in May last while on a holiday visit to Bruges, as recorded in the "JOURNAL" at the time, left estate valued at £5964 gross, of which the net personalty is £5564.

Mr. Samuel Joshua Cooper, of Mount Vernon, near Barnsley, formerly a large colliery owner and a Director of the Barnsley Gas Company, who died on the 11th of July, aged 82, as announced in the "JOURNAL" at the time, left estate valued at £751,446 gross, of which the net personalty has been sworn at £706,627.

The annual conference of the Municipal Water-Works Association, which, our readers may remember, was formed last year, and of which Mr. E. B. Barnard, M.A., the Chairman of the Metropolitan Water Board, is President, is to be held in Glasgow next month. Arrangements are being made for the meeting to be held in the Council Hall, and for a visit by the delegates to Loch Katrine.

Mr. Samuel Beal, of Tulse Hill, a liveryman of the Plumbers' Company and a member of the Court of Common Council, who died on the 20th of June, aged seventy-one, left estate of the gross value of £22,101, of which £14,971 is net personalty. Mr. Beal commenced business in the Old Kent Road in 1877 as a maker of main cocks, pressure-gauges, &c., for gas companies. In 1895, he acquired the business of Mr. Edward Deane, of London Bridge, and about six years ago converted the concern into a private limited liability company, under the style of Edward Deane and Beal, Limited, of which he was Chairman until his death.

We recently received from the Hon. Secretary and Treasurer of the Scottish Junior Gas Association (Western District) the "Transactions" for the session 1912-13. The pamphlet contains the reports of the proceedings at the various meetings and the accounts of the visits to works which appeared in the "JOURNAL," together with lists of the Past-Presidents, office-bearers, and members, and the financial statement. A portrait of the President (Mr. F. L. MacLaren, of Dumbarton) forms a frontispiece. The new session will open on Saturday, Oct. 4. Arrangements are being made for a visit of the members to London on the 18th of October, in connection with the National Gas Exhibition.

WORK OF THE SULPHATE OF AMMONIA COMMITTEE.

Further Agricultural Manurial Experiments.

In the "Journal" for the 19th ult. (p. 490), we noticed some of the agricultural and manurial experiments carried out by the above-named Committee. A report is now to hand of some of their work in Yorkshire having reference to the improvement of grass land.

In the vicinity of Knaresborough, there is a considerable acreage of grass. Much of this is on rather heavy clay overlying the magnesian limestone, from which it would seem probable that these soils are derived. Whatever their origin, they now show no trace of being a limestone derivative, as lime is particularly deficient. Such soils have been regarded as unsuitable for sulphate of ammonia; and with the object of proving this to be incorrect, the Committee arranged with Mr. T. Duncan Mosscrop, of Knaresborough, to supervise a series of hay experiments during the present year. Only a light dressing of freshly slaked lime was applied in the latter half of April; but this was responsible for an increase of more than 4 cwt. per acre. This season was an exceptionally good one for grass, and the hay crops were remarkably heavy. The manures were applied early in May, and in several instances the good effects of sulphate of ammonia were noticeable in three weeks—most of the farmers remarking on the great increase of bottom grasses on No. 3 plot. Without exception, the plots manured with sulphate of ammonia have given large increases; showing that, provided lime is applied where necessary, sulphate of ammonia is a most profitable manure to use on land in this neighbourhood.

Manures were supplied to ten of the best known farmers in the district, and were applied as follows: Plot No. 1 received no manure; No. 2 received 2 cwt. of superphosphate and 1 cwt. of sulphate of potash, at a cost of 17s. 6d.; and No. 3, 2 cwt. of superphosphate, 1 cwt. of sulphate of potash, and 1 cwt. of sulphate of ammonia, costing together 31s. The average increase due to phosphates and potash alone was 3 cwt. per acre, and to the complete manure 17 cwt. per acre. This gives an increase of 14 cwt. of hay due to 1 cwt. of sulphate of ammonia, costing 14s. 6d.—that is, a net profit of £1 14s. 6d. per acre. An exceptionally heavy increase was obtained, of 1 ton 9 cwt., on Mr. Bradley's farm, Castlegate, Knaresborough; the profit from using the complete dressing containing sulphate of ammonia in this case being over £3 10s. per acre.

A curious phenomenon is occasionally to be observed in the conduct of field experiments—viz., that plots manured with phosphates and potash give a lower yield than those receiving no manure. This has occurred on two farms in this district in the present year; and, while it is difficult to give a convincing explanation of the fact, it seems probable that the lower yield is caused by the phosphates hastening the ripening during the hot weather of May and June, together with a shortage of available nitrogen. On corresponding plots to which sulphate of ammonia was applied, there was, of course, a considerable increase.

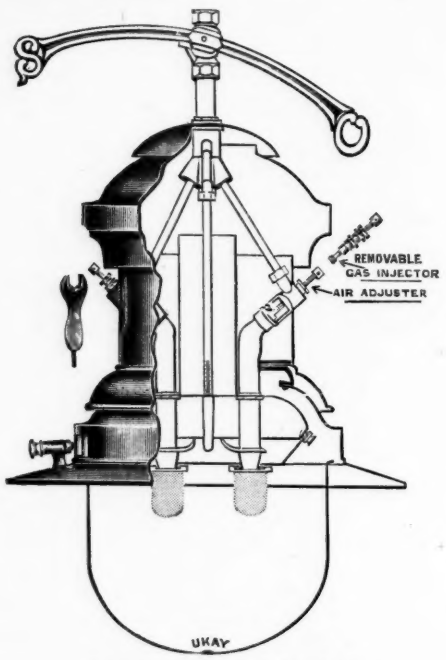
An Early Gas-Engine Maker.—In the last number of the "Journal," a brief announcement was made of the death of Mr. James Robson, who in his early days was constantly experimenting with gas-engines, several of which he constructed and set in operation near his home at North Shields. A few particulars of his work in this connection may be of interest. His first patent for improvements in these engines was taken out in 1877, and this was followed by a later one of 1879. These two patents, though the full credit was not usually accorded to Mr. Robson, must be regarded as the pioneer patents of the "two-cycle" gas-engine; indeed, it may, we think, be stated that all present-day engines of this cycle operate in conformity with his patents. It may probably be remembered that his early commercial gas-engines, working on the two-cycle principle, were manufactured by Messrs. Tangyes Limited, having been introduced about the year 1881; while shortly afterwards this well-known firm brought into the market his patent gas forging-hammer, of which many examples were sold and are still working.

Quality of London Water.—We have received the seventh annual report of the Director of Water Examination of the Metropolitan Water Board (Dr. A. C. Houston), giving the results of the chemical and bacteriological examinations of London water carried on under his supervision in the twelve months ended the 31st of March last. In an introduction, Dr. Houston summarizes his six preceding reports, and by so doing leads up to the one just issued, and makes a complete story. The report and the statistics accompanying it furnish abundant evidence of the enormous amount of work done by this department of the Board in watching over the quality of the water supplied to the consumers; and the conclusion arrived at by Dr. Houston is that the "quality policy" of the Board should be directed towards securing an "epidemiologically sterile water—*i.e.* a water containing none of the microbes associated with water-borne epidemic disease—antecedent to filtration by means of storage (sedimentation, devitalization, and equalization), aided, if need be, by the occasional employment of supplementary processes of water purification."

THE IMPROVED "UKAY" LAMP.

The large measure of popularity enjoyed by previous patterns of the "Ukay" lamp, made by Messrs. Falk, Stadelmann, and Co., of Farringdon Road, E.C., is likely to be still further added to by the improved patented form which is being placed upon the market for the coming lighting season. In fact, though the old name has been retained, the latest pattern shows an all-round advance on previous ones. In its design, the ends which have been aimed at have been the simplification of maintenance and the ensuring of durability.

The principal distinctive feature of the improved "Ukay" lamp is the gas-injector, which can be removed bodily (not the adjusting needle only) from the outside, without taking down or dismantling the lamp. The object of this, of course, is the saving of time and labour on the part of the maintenance man. Any deposit or foreign matter carried forward with the gas can be readily cleared out on the spot, or a new injector may be screwed into the burner by the fitter (for which purpose he can always carry a few spare ones with him) and the old one taken away by him to be cleaned at his leisure. When the injector is thus removed, it leaves a clear way right through to the mantle-nozzle, and admits of a cleaning brush being passed through the burner when necessary—emphasis being laid by the makers upon the fact that the burner itself must be cleaned from time to time if the best results are to be obtained. The adjustment is, it may be mentioned, effected from outside the casing in the usual way. A tool is supplied with the lamp, one end of which fits the lock-nut on the gas-adjuster, while the other is arranged for use in adjusting the air or gas supply—both adjusters being operated capstan fashion by the loose key, so as to prevent irresponsible tampering with them when once set to suit local conditions. It may be added that the needle injector works through a stuffing-box packed with asbestos. Another feature from the maintenance aspect is the provision of an aluminium inner chimney, with a cup-shaped bottom fitting over the burners. The advantages that are urged for the use of this metal are that it cannot possibly chip or flake, and does not induce condensation when cooling.



Improved "Ukay" Outdoor Lamp.

These are good features from the maintenance point of view, but there are still some other things to be said about the lamp. For example, there is the question of accessibility of interior parts, which are interchangeable, and can be easily renewed. To expose the burners and interior of the lamp, all that has to be done is to unscrew a lock-nut at the top of the casing, and lift off the cover. Each burner is connected with the gas-way proper by a union, so that there is no difficulty in its removal, if requisite; and each is separately controlled. As to the air-adjuster, this also has its own particular feature, inasmuch as the burner is fitted with a sliding liner, which is moved towards or away from the gas-injector. This is claimed to be a great improvement on the customary movable-sleeve air-adjuster, its object being to impart a higher velocity to the gas and air mixture, and thus to secure an increased illuminating power. There are no inner glasses to the mantles, as they are not found to be necessary. At the inlet to the cock, there is a dust and condensation trap; and the bye-pass is neatly arranged, being carried round the body of the cock and run centrally through into the lamp. Only one bye-pass jet is

provided; and this is in a vertical position, to obviate carbonizing. Above the burner-nozzles there are skids, under which the gas collects when the cock is turned on, ignition at the burners being smoothly accomplished.

The lamp is British made throughout, and substantial in all respects. It can be had either with enamelled steel or copper casing. All the parts are made of cast or turned brass; no iron being used, except for the lever. The pattern now specially referred to (which is actually "in being") is for outdoor use, and is supplied in one, two, three, and four light sizes. Its efficiency is placed at 125 candles per burner, with a gas consumption of 4 cubic feet per hour. The firm are, however, adapting the same principles to indoor and to high candle-power lamps. They feel that the novel type of gas-injector, which is really the main feature of the improved "Ukay" lamp, will be appreciated by the gas profession; and this being so, they are naturally determined to extend its use. They have done their best to combine the utmost simplicity of maintenance with the largest measure of durability; and this is an object in which they may safely anticipate the cordial support of the industry.

A NEW MANNESMANN LAMP

And a Gas Lighter.

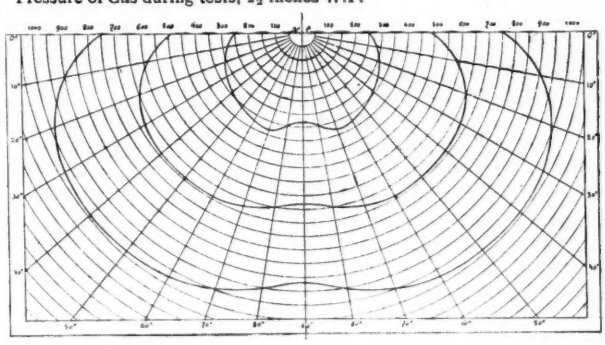
THAT full preparation has been, and is being, made by gas-lighting apparatus manufacturers and factors to cope with the demands of the forthcoming lighting season, is borne in upon one when glancing through the contents of different show-rooms; and certainly no exception to the application of this remark can be made in the case of Messrs. J. & W. B. Smith, of Farringdon Road, E.C. In the course of a visit last week, the firm directed attention to several fresh lines which are being introduced.

First among these may be mentioned a new type of Mannesmann high-power low-pressure lamp—this time for outdoor lighting. The remark "this time" is made, because in the "JOURNAL" about eighteen months ago a description was given of a Mannesmann indoor lamp, which included certain of the features embraced in the present form. The indoor lamp achieved considerable success last season; and at least an equal share of good fortune is confidently anticipated this year for the outdoor lamp, as well as for a new pattern of Mannesmann lamp for interior lighting which is a little smaller than last season's. It will be noticed from the illustration that the casing of the outdoor type has a revolving shutter, which gives ready access to the gas and air adjusters, both of which are inside the casing. To retain the shutter in place, there are slots cut in it, into which projections on the lower part of the casing fit; and when desired to alter its position, the shutter can be raised clear of the projections by means of the two knobs provided on the sides. These lamps are made for two or three lights; and another feature of them is to be found in the aluminium non-corrosive inner chimney over each burner. The use of this metal for the purpose named promises, indeed, to become quite popular, in view of the advantages which it apparently possesses. The casing is steel, finished in black enamel; and the cast brass burners and fittings are of really substantial make. It is a good looking lamp, which would not be out of place in any required situation. In the one-burner form, the revolving shutter is not provided; but there are several points about a shutter of this kind—the use of which in connection with lamp-casings is, of course, already known. Though the gas and air adjusters are enclosed, and so protected from weather influences, they can be got at without trouble for regulating or cleaning purposes. The gas-regulator is vertical, and when the needle is removed, any obstruction can be straightway blown through the nipple. The patent air-regulator is of the simple but ingenious form already indicated in our pages. The air apertures are of a fixed size, but there is a screw which passes into the bunsen tube, and cuts across the gas-way—thus regulating the velocity of the discharge of gas, and consequently the amount of air drawn in. The lighting efficiency claimed for the lamp is about 40-candle power per cubic foot of gas consumed; the one-light form being stated to give approximately 300 candle power, the two-light 600 candles, and the three-light 1000 candles. The following tabulated results of tests of these outdoor lamps—one series, it will be seen, having been made by Professor Drehschmidt—show what they are capable of accomplishing.

Candle Power of Original Mannesmann Intensive High-Power Low-Pressure Outdoor Lamps.

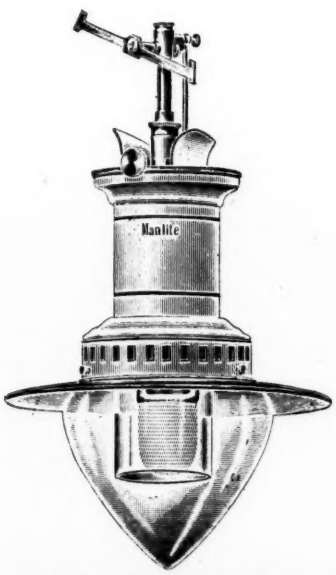
	Results taken in the Laboratory of the Municipal Gas-Works of the City of Berlin by Professor Drehschmidt. B.Th.U. of Gas, 21,000.		Results taken in the Laboratory of the Mannesmann Works at Remscheid (Germany). B.Th.U. of Gas, 22,610.	
	One Light.	Three Light.	Two Light.	Three Light.
Taken at an angle of 0° below the horizontal	224 C.P.	676 C.P.	435 C.P.	786 C.P.
,, 10°	259 ,,	769 ,,	530 ,,	824 ,,
,, 20°	278 ,,	807 ,,	595 ,,	897 ,,
,, 30°	293 ,,	833 ,,	618 ,,	938 ,,
,, 40°	305 ,,	860 ,,	622 ,,	952 ,,
,, 50°	330 ,,	860 ,,	622 ,,	950 ,,
,, 60°	343 ,,	842 ,,	622 ,,	938 ,,
,, 70°	343 ,,	805 ,,	620 ,,	915 ,,
,, 80°	313 ,,	791 ,,	595 ,,	873 ,,
,, 90°	301 ,,	755 ,,	572 ,,	840 ,,
Average Candle Power	299 C.P.	799 C.P.	583 C.P.	881 C.P.
Consumption of Gas	7·8 Feet	23·9 Feet	15·8 Feet	24·2 Feet

All Candle Powers are British Sperm Candles. One Hefner Candle equals 0·915 British Sperm Candle.
One British Thermal Unit equals 0·252 German Thermal Unit.
Pressure of Gas during tests, 2½ inches W.P.

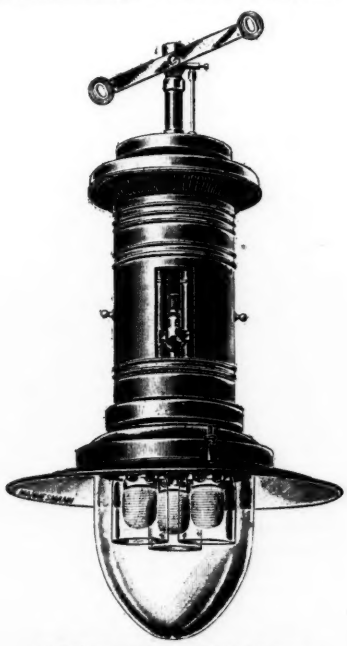


Illumination Curves of the One, Two, and Three Light Lamps.

An interesting little contrivance to be seen in action in the firm's show-rooms is the "Telefunken" automatic gas lighter.



New Pattern Mannesmann Indoor Lamp (called the "Manlite").



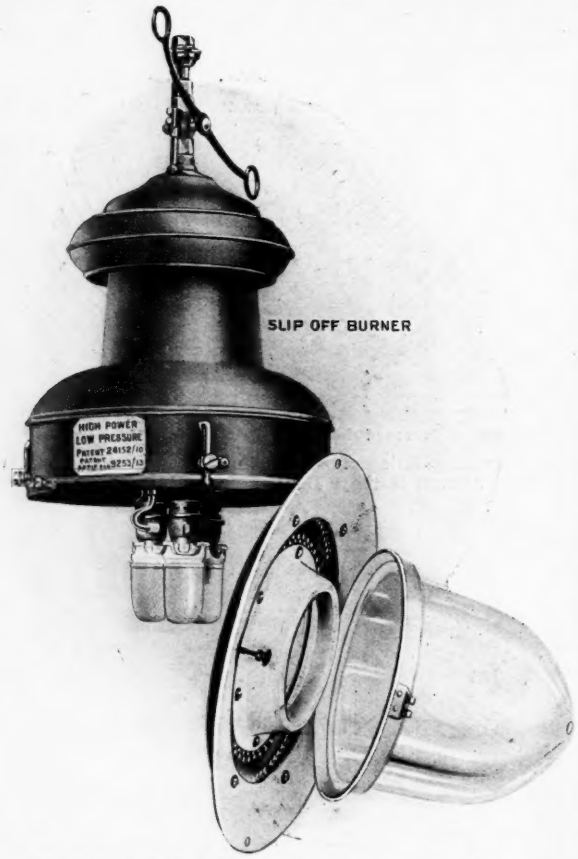
The Mannesmann Outdoor Lamp.

The "Telefunken" Gas Lighting Arrangement.

This is an arrangement which can be fitted to any burner, by simply adjusting the bye-pass tube. The action of the lighter will be gathered from the illustration. There are two levers—for lighting and extinguishing respectively. On depressing the right-hand lever, the bye-pass is opened, as well as the gas-way proper, and sparks are emitted by the cerium-iron igniter above the burner. These sparks immediately light up the bye-pass beneath, which in turn ignites the gas at the burner. Depressing the left-hand lever shuts off the main gas supply. The right-hand lever is fitted with a self-acting backward movement; and when it is released, the bye-pass jet is extinguished. It is also advanced as a substantial point in favour of the appliance that, should the lever be unintentionally moved, or the lighting lever not be pulled down far enough to cause sparking, the gas supply is automatically cut off, thereby obviating the danger arising from an unnoticed escape of gas. It is stated that the sparking device will last for two years, at the end of which time the cerium tip can be renewed at trifling cost. A mica shield is supplied for the protection of the lighter from heat and products from the burner; and if desired the right-hand lever may be provided with a luminous plate, enabling it to be instantly found in the dark. The lighting spark of the specimen apparatus inspected was a powerful one, and the action was rapid and certain. It may be mentioned that the two levers are independent of each other, an arrangement which permits the extinguishing lever to be used as a gas-regulator. The lighters can be applied to high-pressure burners also; and it is stated that 3000 installations of the apparatus have already been fitted up, without any failures.

THE "NEWBORN" HIGH-POWER LAMP.

The gas industry of the present day has at its disposal many excellent patterns of lamps with the aid of which to fight the battle that it so successfully carries on with its competitors; and among these lamps, the productions of Messrs. A. E. Podmore and Co., of Charles Street, Hatton Garden, E.C., have long held a foremost place, not alone in this country, but in many other parts



The "Newborn" High-Power Low-Pressure Outside Lamp.

of the world as well. The fact, however, that they have already achieved so large a measure of success, does not—and quite rightly so—deter the firm from engaging in continuous investigations and experiments for the purpose of introducing fresh improvements when found practicable; and the natural result is the appearance from time to time of new styles of lamps.

An instance of this was afforded to the writer last week, when he was invited to inspect at Charles Street an up-to-date form of outdoor high-power low-pressure lamp, upon which the firm have bestowed the appropriate name of the "Newborn." The main object of its design has been to enable the fitter or maintenance man, when any repairs or adjustments have to be carried out, to get at the burners inside the lamp without the necessity of taking it down. It will be admitted that it is a very good object to aim at obviating the necessity of taking a lamp down and getting it to pieces when it is desired to come to the interior; for this operation would entail its removal to the shop or works, or some other suitable place. Early renewal of the different parts is not, of course, anticipated. But when, after a number of years' wear, this may be called for, or when cleaning is to be done, it is possible to get right into the interior of the "Newborn" lamp, or to exchange any of the wearing parts, by the mere releasing of a few screws. The base-plate (which is the subject of a patent) is hinged, and can be released in a few seconds, after which the burners can be taken out. Then, again, the enamelled portion surrounding the burners is a wearing part; and this can be removed from the bottom plate by the undoing of six screws. If, too, the deflector or reflector gets damaged from some cause, all that has to be done is to release another set of screws in the base-plate, and fix a new part. The fitting of a new globe gallery is also quite a simple affair.

Glancing at the details of the lamp, which is British made throughout, it was noticed that the burners employed are of the firm's well-known angle type, of a stated power of from 250 to 300 candles; and, as a matter of fact, in many respects it is on the lines of previous patterns. As already remarked, the firm have worked on the experience they have gained with lamps that have been sent out since the time of the Manchester Gas Exhibition some six years ago, when, as they point out, they showed the only cast angle-burner lamp that was exhibited. By degrees, as time has gone on, improvements in constructional details have been effected, with the idea of strengthening parts as might be found desirable, and of generally simplifying the lamp from a maintenance point of view. The new lamp is made in two, three, and four burner sizes; and the inner portion is of heavy aluminium—a metal which it is found to be advantageous to employ for the purpose. A point to be borne in mind, however, is that lamps which have been out some years can have the patent perforated base-plate fitted to them, and thus be brought right up to date, at very small expense. Outside gas and air adjustment is provided; and the needle of the gas-adjuster can be removed without opening the lamp, and a wire passed through for clearing away any obstructions. The "insect-proof" reputation so far gained by Messrs. Podmore's lamps will be maintained in the case of the present pattern; for, when required to be used in places where insects prove troublesome to gas lighting, a fine mesh nickel gauze is placed over the air-holes in the base-plate. As this is the only way by which such intruders could otherwise enter, they are effectually kept out. One bye-pass operates all the burners contained in a lamp; and a point which attracts attention is that both the globe gallery and base-plate hinges have pins which are easily removeable, should it be desired to do this. The use of a reflector is optional; and without it, a light is obtained right up to the head of the lamp. While speaking of the head of the lamp, too, it may be remarked that this is fashioned out of very heavy material, as with high-power lighting the heat experienced at this spot is naturally greater. To be precise, it is formed of No. 19 gauge steel before enamelling—or if copper is used (in which metal the lamp is also supplied) it is of the same gauge. A number of lamps have during the past year been sent out fitted with an aluminium shell inside the head; and that they have proved entirely satisfactory is assumed from the fact that no complaints regarding them have been received.

An excellent idea of the lamp to which these brief remarks apply will be gathered from the accompanying illustration, which shows both globe gallery and base-plate released and swinging on their hinges. The lamp is not altogether untried; for it has been on the market for some months, and is going very well. There is thus a certain amount of safety in prophesying that it has a good future before it. Its substantial character in all respects will not fail to be noted.

North British Association of Gas Managers.

We have received from the Secretary and Treasurer (Mr. L. Hislop, of Uddingston) the programme of the annual meeting of this Association, which, as already announced, will be held at Greenock on Thursday next, under the presidency of Mr. James Macleod, F.I.C., F.C.S., the Gas Engineer and Manager to the Corporation. The members will be welcomed by the Provost (Mr. W. B. MacMillan), and also by the Convener (Bailie J. H. Taylor) and members of the Gas Committee. The opening business will consist of the reading of the minutes of the last annual meeting, the presentation of the reports of the Council and the Auditor, with the statement of accounts, and the admission of new members. The President will then deliver his Inaugural Address, which will be followed by the reading and discussion of papers, a list of which was given in the "JOURNAL" for the 12th ult. (p. 426). After luncheon, Dr. W. B. Davidson, F.I.C., of Birmingham, will give the Second William Young Memorial Lecture, which will be on "Possible Economies in Gas Manufacture;" and the rest of the time at disposal will be devoted to any technical business remaining, and to the election of office-bearers, the fixing of the place for next year's meeting, and other matters. In the evening, there will be a complimentary dinner to the members and lady friends in the Town Hall. Next day (Friday), an excursion will be made to Arran, *viâ* Rothesay and the Kyles of Bute, returning *viâ* Garroch Head.

THE DESIGN OF A GASHOLDER.

By ENGINEER.

(*Concluded from p.* 555.)

Guide-framing: Theory and Application.

We will proceed to consider the guide-framing from a theoretical aspect, and will later discuss the choice of sections, looking to the practical application of the figures arrived at. As the position of the holder was not abnormal, the wind pressure can be taken at 16 lbs. to the square foot of projected section—*i.e.*, diameter multiplied by height.

The columns are subjected to a cantilever stress; the pressure being transmitted on one side directly by the rollers attached to the holder at the corresponding points. If tangential as well as radial rollers are used, this pressure is transmitted direct to nearly all the columns; but, in any case, the bracing transmits the pressure through the whole structure.

The horizontal girders are the struts, and the diagonal bars are the ties. The whole guide-framing, therefore, can be treated as a huge cylinder, stiffened by a thin internal ring (the holder itself), the value of which, other than as a stiffener, is neglected in the calculations. The tendency of the ring itself to buckle is overcome by the stiffness of the holder curbs, the cups, and the vertical guides or stiffeners—in fact, each lift must be rigid in itself without assistance from the guide-framing.

The total capsizing force tends (1) To break the holder off at the base and overturn it; (2) to distort the framing out of its cylindrical form. The cantilever as a whole, therefore, has to overcome only the first of these tendencies, in addition to which each separate cantilever has to overcome the bending moment due to the wind in its particular section. The total vertical shear in each cantilever is then resolved along the other parts of the framing—horizontally for the struts and diagonally for the ties—as in the case of a braced cantilever girder whose maximum shear can be found. The total capsizing force at the top of the holder

$$= \frac{8\ D\ d^2}{H} + \frac{D^3}{3\ H} \text{ lbs.}$$

Where D = diameter in feet.
d = height of holder in feet.
H = height of guide-framing = d (nearly) in this case.

$$\therefore \text{ total force} = 8\ D\ d + \frac{D^3}{3\ d}$$
$$= 8 \times 152{\cdot}5 \times 106 + \frac{(152{\cdot}5)^3}{3 \times 106}$$
$$= 140{,}580 \text{ lbs.} = 62{\cdot}8 \text{ tons.}$$

$\therefore$ Bending moment = $62{\cdot}8 \times 106 = 6640$ foot tons.

The moment of resistance to overturning is got from the usual formula

$$M\ R = \frac{S\ I}{y}$$

Where S = working stress = 6 tons per square inch.
I = total moment of inertia of the cylinder.
y = half depth of section = $\frac{D}{2}$ approximately.

taking the holder diameter as equal to that of the column circle, which is near enough.

The total moment of inertia of the combined section can be found by adding all the elements by the formula $Ix = Io + A\ D^2$. But a shorter approximate method is given by Rankine's formula

$$M\ R = \tfrac{1}{4}\ n\ A\ D\ S$$

Where n = number of column.
A = area of each column in square inches.
and other symbols as before.

$\therefore$ $M\ R = \frac{1}{4} \times 28 \times A \times 152{\cdot}5 \times 6 = A \times 6405$ foot tons.

Equating this to the bending moment, we get

$6640 = A \times 6405$, from which A = 1·04 square inches.

This result can be obtained from a single formula deduced from the above—namely:

$$A \text{ (area of each column)} = \frac{24d^2 + D^2}{10{,}000\ n}$$
$$= \frac{24 \times 106 \times 106 + 152{\cdot}5 \times 152{\cdot}5}{10{,}000 \times 28} = 1{\cdot}04 \text{ square inches}$$

This is the area required in each column to prevent failure of the cantilever *as a whole.*

We now have to consider the bending moment on one bay only, tending to cause distortion.

$BM = \frac{Bd^2}{270}$ inch-tons. Where B = the breadth between the girders in feet

$$= \frac{17{\cdot}75 \times 106 \times 106}{270} = 742 \text{ inch-tons}$$

To find the section for each column to withstand this, equate it to the moment of resistance.

$\frac{SI}{v}$ or SZ. Where Z = Section modulus
S = C tons □″ as before

$$\therefore Z = \frac{742}{6} = 124 \text{ inch-units}$$

We must now choose a section of this modulus, and, allow 1·04 square inches additional for total overturning influence. This modulus is only necessary at the base of the column (adjoining the tank), and may decrease towards the top.

If instead of treating the above formula to get the modulus of section, we use it to find the necessary area from the approximate formula

$MR = SA\,d$. Where d = depth of section (effective) E
A = area of each flange
S = working stress

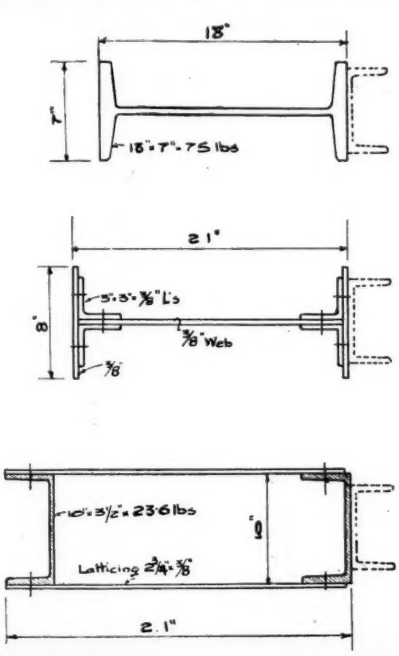
we must assume a working depth (say) 20 inches.

$\therefore 742 = 6 \times A \times 20$ and A = 6·2 square inches, or 12·4 square inches in both flanges.

Thus if we adopt a plate girder we must have 12·4 square inches in flanges, and a depth of 20 inches, in which case more than the required 1·04 square inches is provided in the web; and if we adopt any system lattice braced, we must have 13·44 square inches in the flanges and a depth of 20 inches. We can also check our rule for required modulus of section. To save time, sections of standards are shown in fig. 4, with various particulars attached.

Choice of Section of Main Standards.

There are other variations which will readily suggest themselves to the reader; but these are sufficient to illustrate the principle.



TYPE OF STANDARD	FLANGE AREA	SECTION MODULUS	WEIGHT PER FOOT
	SQ INCHES	INCH UNITS	LBS
Rolled Steel Joist	13·5	127·6	75
Plate Girder	13·6	146·2	76
Lattice Braced Girder	13·8	135·4	62

Fig. 4.

It will be noted that the flange area of the plain girder is at a depth of 17 inches, and therefore should be 14 square inches to be comparable to the other two sections, which have an effective depth of 20 inches. The third section is attractive regarding weight; but other matters have to be considered.

The plain girder seems slightly deficient in flange area; but looking to the fact that it has the assistance of the guide channel, which can be strongly riveted to it in a simple manner, this section is permissible, as it has the necessary modulus. The plain girder being much cheaper per ton than the plate or lattice braced variety, it is really more economical than No. 2 and about equal to No. 3. In addition, it has no metal in it less than 0·55 inch thick, and is therefore better able to stand corrosion, and is the cheapest section for maintenance. These advantages in its favour led to its adoption for the main standards.

Stresses in Struts and Ties.

We must now find the maximum vertical shear in the girder. This is obtained from the formula $\frac{24d^2 + D^2}{10{,}000}$ tons, symbols as before

$$= \frac{24 \times 106 \times 106 + 152{\cdot}5 \times 152{\cdot}5}{10{,}000} = 29{\cdot}4 \text{ tons.}$$

The bracing consists of four horizontal struts and four rows of ties, along which this stress is resolved. See fig. 5.

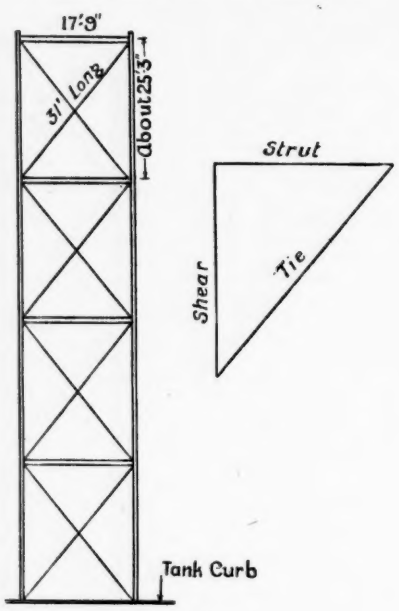


Fig. 5.

Total compression in struts $= \frac{17{\cdot}75}{25{\cdot}25} \times 29{\cdot}4 =$ 20·8 tons.

Total tension in ties $= \frac{31{\cdot}0}{25{\cdot}25} \times 29{\cdot}4 =$ 36·1 tons.

Max. compression (bottom strut) $= \frac{4}{4+3+2+1} \times 20{\cdot}8 =$ 8·32 tons.

Maximum tension (bottom tie) $= \frac{4}{4+3+2+1} \times 36{\cdot}1 =$ 14·44 tons.

We now have to design a strut 17 ft. 9 in. long, to withstand a compression of 8·32 tons. These struts constitute a case where practical considerations are of importance. It is essential that the top of the holder framing should be absolutely rigid, as there is a tendency under certain conditions to produce torsion. So that, although theoretically the top strut is subject to very little compression ($\frac{1}{10}$ of 20·8 tons), we must have a stout member to resist deformation due to torsion or other causes. The torsion is a maximum at the top, in contrast to the tensile, compressive, or bending stresses. The lower strut members also require to have stiffness as well as to resist compression, and no sagging must be possible, as it is necessary to keep the vertical standards in a perfectly straight line under all conditions. It is therefore quite common to see all struts of the same section; but in all cases the top strut should be as stout as that immediately below it.

To meet all these requirements, it is not advisable to use less than 10-inch by 6-inch by 42 lbs. girders, keeping to the simple girder construction before utilized. It would be possible to utilize smaller girders for the two intermediate rows; but for reasons above mentioned, it was decided to keep the same section from top to bottom—thus standardizing all the struts and the connections associated with them.

It would be now useful to apply the usual strut formulæ to our section, and we find the following working loads are arrived at—using in all cases a working stress of about 6 tons □", or a factor of safety of:

By Euler's formula = 12·0 tons working load.
„ Rankine's „ = 13·6 „ „ „
„ Johnson's „ = 19·6 „ „ „
„ Gordon's „ = 12·3 „ „ „

This shows that we are well on the safe side; and these working loads would be materially reduced if our girder were reduced to 5 inches in width, in addition to which the ratio $\frac{\text{length}}{\text{least dimension}}$ or $\frac{\text{length}}{\text{least radius of gyration}}$ would be too large for the application of the formulæ.

The strut is, of course, taken as with rounded ends, and constants used accordingly.

The main tension members should have an effective area of $\frac{14{\cdot}44}{6} = 2{\cdot}41$ square inches if of steel, or about 3 square inches if of wrought iron. Thus a $1\frac{3}{4}$-inch diameter steel bar or 2-inch wrought-iron would suffice. A $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. angle or 4 in. by 3 in. channel would suit, after allowing deductions for rivet or bolt holes. The round bars, however, are simpler for connecting to standards, and allow of adjustment by means of central rings or coupling screws. So wrought-iron rods were adopted here, 2 inches in diameter in the top and bottom bays, and $1\frac{3}{4}$ inches in the middle bays. The rods were thickened at the screwed ends, so as not to reduce the effective area; and at the vertical standards an eye was wrought from the bar itself, which had equal strength to the bar in all directions. The eye was put between double plates. Thus the pin was in double shear. Out of each pair of ties per panel, only one at a time is in tension; but to provide for stress in either direction, two must be inserted.

This completes the main features of the guide-framing. But there is another type of the multipost framing frequently met with—that adopted by Messrs. Cutler, in which there are no horizontal struts. All the members between the standards are sloping; thus we have a Warren cantilever girder for each bay, each sloping member being designed to withstand the maximum compressive stress, in which case it is of ample size for tension. In this system there is a stout horizontal box-girder at the top, which keeps the cylinder rigid and meets the possible torsion above referred to.

Top Curb Stresses.

The most important feature in the holder is the curb in the top lift. There is, of course, no trussing in the crown of a holder of this size. The type adopted is shown in fig. 6.

The compressive stress in the curb is given by the formula

$$\frac{(a^2 - b^2)\ p\ D}{8\ b} + 6{\cdot}5\ D\ d - \frac{p_1\ D\ d}{c} \text{ for one side.}$$

Where a = half the diameter in feet = $72\frac{1}{2}$
b = rise in crown „ „ = $9\frac{1}{2}$
d = depth of inner lift „ „ = $26\frac{2}{3}$
D = diameter „ „ „ „ = 145
p = effective pressure of gas in lbs. per square foot.
p_1 = actual „ „ „ „ „ „

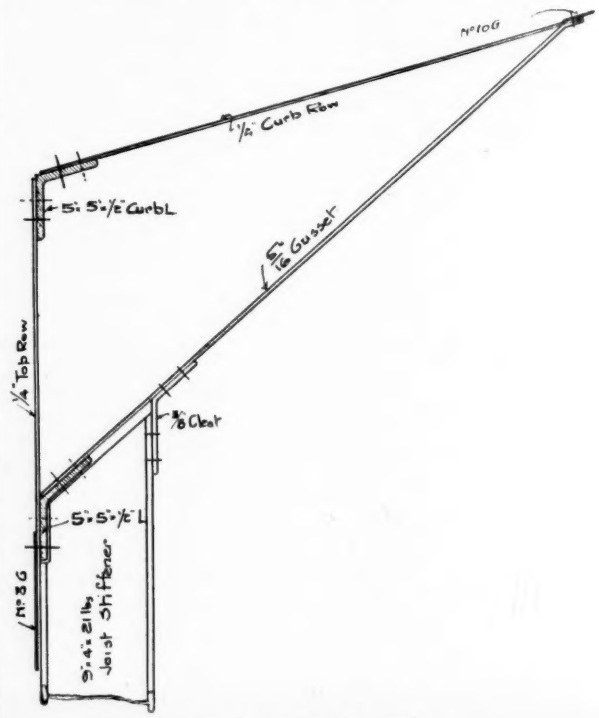


Fig. 6.—Details of Top Curb.

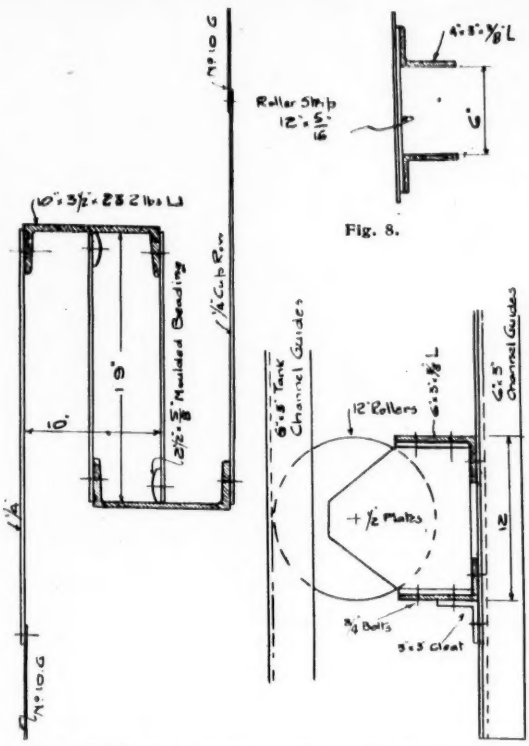


Fig. 7.—Details of Cup and Grip.

Fig. 9.—Details of Bottom Curb.

c = a constant which is 10 for vertical stays fastened all the way up and 16 for loose vertical stays (10 in our case).

$$p = \frac{\text{total weight of gasholder in lbs.} - \text{weight of top sheets}}{\text{area in square feet}} = \frac{(324 - 47) \times 2240}{16{,}560} = 36{\cdot}5$$

$$p_1 = \frac{\text{total weight of gasholder in lbs.}}{\text{area in square feet}} = \frac{324 \times 2240}{16{,}560} = 44{\cdot}0$$

$$\therefore \text{Compression} = \frac{(72{\cdot}5^2 - 9{\cdot}5^2) \times 36{\cdot}5 \times 145}{8 \times 9{\cdot}5} + 6{\cdot}5 \times 145 \times 26{\cdot}7 - \frac{44{\cdot}0 \times 145 \times 26{\cdot}7}{10}$$

$$= 369{,}200 \text{ lbs.} = 166 \text{ tons.}$$

To resist this, we must put sufficient effective area in the curb. In this form of construction the whole curb is made rigid, and therefore we treat it as in pure compression, without tendency to buckle. We consider this compressive stress as met by the two angle curbs, gusset plate, the top row of side sheets, and the outer row of crown sheets, after making due allowance for the type of riveting. If these plates were butted, we could consider the whole section; but as the commoner method is to lap them, we must take only the rivet areas along each line, acting in single shear, which materially reduces the strength. The top and side sheets would be riveted by ½-inch rivets about 1¾-inches pitch. So that the top sheets have about 26 rivets, and the side sheets about 18 rivets. The gusset plate could with advantage be butted; and we therefore take all its area. As the strength in single shear is about 5-6ths that of compression, we must make this adjustment to get the effective areas.

Effective area, outer row crown sheets	$= 26 \times \frac{\pi}{4} \times \frac{1}{2}^2 \times \frac{5}{8}$	=	4·20 sq. ins.
,, ,, top ,, side ,,	$= 18 \times \frac{\pi}{4} \times \frac{1}{2}^2 \times \frac{5}{8}$	=	2·90 ,,
,, ,, two curb angles	= (5in. × 5 in. × ½ in.)	=	9·50 ,,
,, ,, gusset plate 54 in. by $\frac{5}{16}$ in.		=	17·00 ,,
			33·60

Therefore, the compressive stress $= \frac{166}{33{\cdot}6} = 5$ tons per square inch.

If the curb area were deficient—*i.e.*, the stress above 6 tons □″—the deficiency could be made good by thickening the curb rows of sheeting, increasing the section of the curb angles, or by making (say) the crown row of butt joints. It would be cheaper to thicken-up the angles or plates than to butt the joints.

We have now dealt with the most important parts of the design from a theoretical and practical point of view. With regard to the remaining features, when considering such a holder as this one (without flying lifts), we must rely on judgment and constructional considerations to guide in the selection of suitable sections, &c.

Cups and Grips.

Perhaps the first remaining point of importance is the section for cups and grips. An excellent section is that shown in fig. 7, with notes following.

The channel section is adopted as being satisfactory for stiffness and constructional economy, as the riveting is reduced to a minimum. The advantages over the semi-circular section are no initial strain due to bending, and no grinding of the cup if the lifts are not quite central when cupping. The 10-inch width is to allow more clearance and ease of riveting, although the 8-inch is good enough for smaller holders. The stout ¼-inch cup side is advisable for resisting the corrosion due to the changing level of water; and the moulded beading makes the plate more rigid. The 10-inch channel, when used in a cup which is only 17 feet between the points of support, is amply sufficient to take the bending caused by the thrust from successive supports, and avoids springing. Incidentally, another advantage of closely-pitched standards is to reduce the amount and leverage of this thrust, as well as shortening the distance between the supporting points. The depth of 1 ft. 9 in. is advisable, looking to the total pressure of the holder, the sudden change of level when cupping, and the safe margin required. In any holder of more than (say) 25,000 cubic feet, 18 inches should be adopted.

Vertical Stiffeners, Bottom Curb, and Rollers.

The vertical stiffeners should consist of 9 in. by 4 in. by 21 lbs. section joist for the top lift, and secured to each row of plates. The stiffeners in the remaining lifts act as guides; and a suitable section is 6 in. by 3 in. channel. If plain strips for the roller-guides are used, a pair of angles flanking the plates should be riveted, as in fig. 8, or alternatively a stiffener put on the outside of the lift. The method sketched is, of course, dearer than the channel.

The same section of channel would be suitable for the tank-guides or plate and angles as above. Use channel guides for the framing. The bottom curb of the outer lift can be made in many ways. A 9 in. by 3½ in. channel is suitable, or two angles 6 in. by 3 in. may be used, giving a 6-inch depth, as in fig. 9. The latter method is stronger, but a little more expensive.

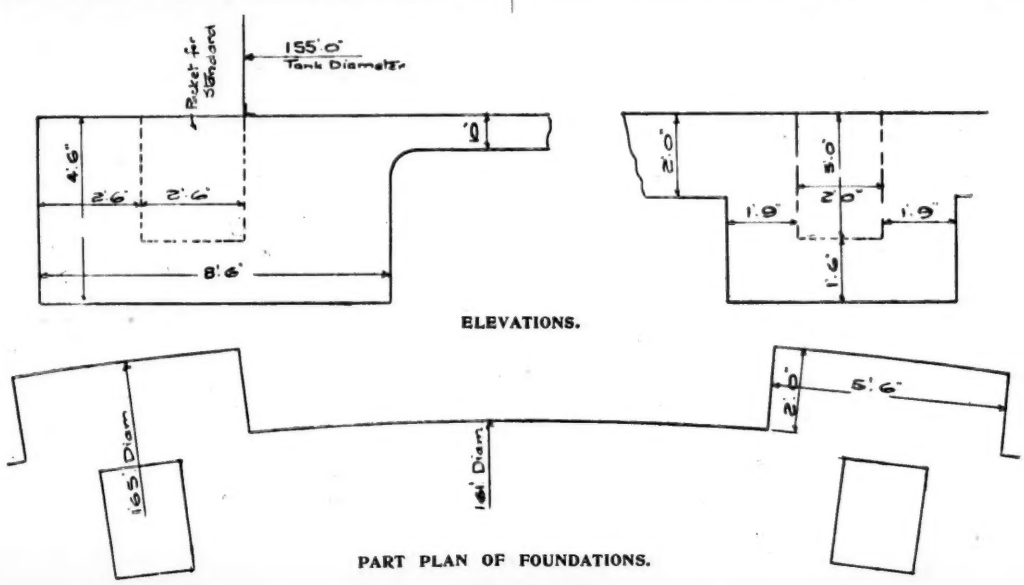
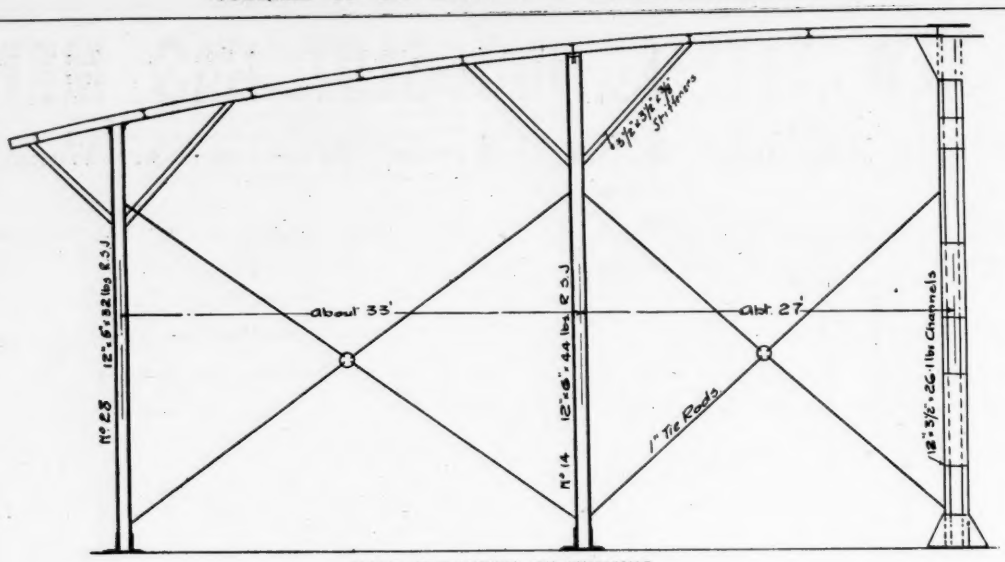
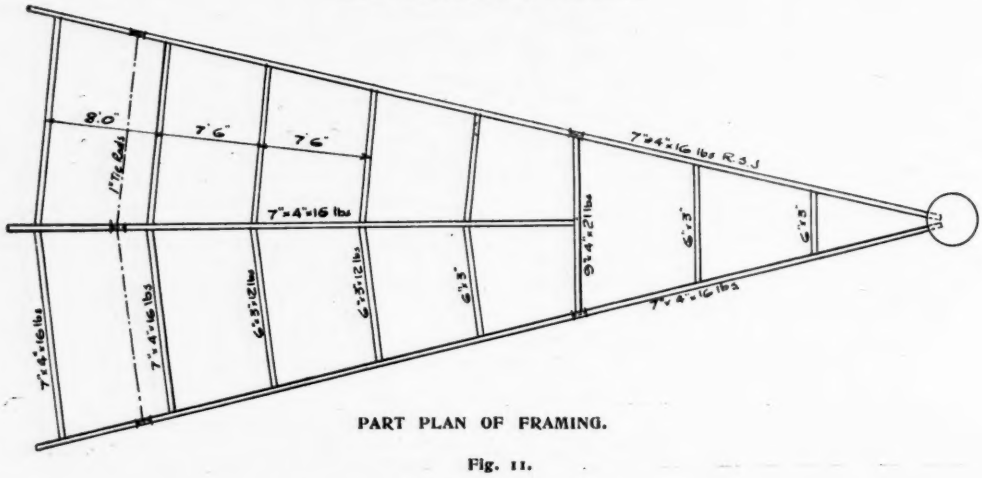


Fig. 10.



HALF ELEVATION OF FRAMING.



PART PLAN OF FRAMING.

Fig. 11.

The diameters of the top rollers are 24 inches, 18 inches, 15 inches, and 12 inches diameter, commencing at the upper lift. The bottom rollers are 9 inches, 9 inches, 9 inches, and 12 inches diameter respectively. All are 3 inches on the face.

The whole of the rollers are made adjustable without interfering with the gasholder sheets. This can be effected by making the frame carrying the rollers capable of sliding over their bases, or, better still, by having the roller itself mounted in a frame in the carriage and independently adjusted by means of a screw. All rollers should be fitted with Stauffer's lubricators. All riveting to roller-guides should be countersunk into the latter.

Sheeting.

The sheeting is as follows:

All cup and curb rows, $\frac{1}{4}$ inch by about 2 ft. 6 in.
Crown curb row, $\frac{1}{4}$ inch by about 3 ft. 9 in.
Riveted by $\frac{1}{2}$-inch rivets, $1\frac{3}{4}$ inches pitch.
All side sheets, except the top lift, No. 10 gauge.
Crown sheets, except the outer row and the centre plate, No. 10 gauge.
Top lift side sheets, No. 8 gauge.
All riveting to thin sheets, $\frac{5}{16}$ inch, $1\frac{1}{8}$ inches pitch, and $1\frac{1}{8}$ inches lap.

The only other points of interest are the foundations and the framing for resting the crown.

Foundations.

The foundation arrived at (good ballast) did not warrant expensive concreting, nor was any reinforcement or special precaution necessary. Fig. 10 will indicate the foundations better than any description. The boxes for the pocket holes for the standards are made of rough timber, afterwards taken out, and when standards are fixed the holes are filled with fine concrete.

The total pressure per square foot on the ballast is only 0·8 ton per square foot.

Framing to Rest Crown.

This should be made as light as possible, and must rest in the tank—the diameter being too large for a trussed crown. [The formula for the curb stress in a trussed crown would need amendment.] A timber framing would do; but a steel one is rather cheaper and generally more reliable. There are many types of steel framing; but all have similar features. That adopted for this holder consists of a centre post, with two circumferential rows of standards, with radial bearers and annular purlins. The centre post is built of two channels, and suitably braced. The outer row of standards numbers 28 (the number of the guide-frame standards); while the inner one may by suitable arrangement of radials and purlins be reduced to half this number. The arrangement is seen in plan and elevation in fig. 11. The sketch shows that no purlin or radial bearer becomes of excessive span.

Having arrived at the number and arrangement of standards, we get the average load per square foot to be supported by the framing; adding to the actual weight of the top lift 4 to 5 lbs. per square foot for snow load, corresponding to 9 inches to 12 inches of snow. We can then apportion the amount carried by each purlin, radial, or column. It will be found that, owing to their great height, the columns would have to be very heavy, unless their span be effectively reduced by bracketing between the columns and girders by $3\frac{1}{2}$-inch or 4-inch angle steels. This also has the effect of materially reducing the clear span of the radial bearer or purlin to which it is attached.

Another method is to have a horizontal row of stiffeners, half way up the standards, running circumferentially. The standards are further braced by diagonal tie-rods, 1-inch diameter, with central rings for adjustment. The outer row is tied by these rods circumferentially; and the fourteen lines of standards are braced radially, as shown in the elevation. The sketch gives the principal dimensions. The radials and purlins are shaped to the crown; and this slight arching gives them extra stiffness.

There are, of course, many points omitted of importance, and many which could be enlarged on; but as the article is already longer than anticipated, they have been crowded out. Sufficient, however, has been given to show how one may combine theory with judgment and experience. Taken in conjunction with the original circular of the American Gas Institute, and the writer's answers to same [in the article referred to in the opening paragraph of this thesis], it has been shown how such a gasholder is designed in the office as apart from the care and thought exercised by the contractor in actually making and erecting the structure. The details of manufacture and erection would form a useful complement to this and the previous publications, and sufficient material would be at hand to furnish an article or paper of considerable interest.

WASTE OF AMMONIA.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

The annual reports of the Chief Inspector under the Alkali Act are always welcomed and received with more attention than any other Government return, because they comprise something more than a mere compilation of statistics. One would like to see a document such as the Parliamentary Returns of gas undertakings dissected and discussed in detail on a similar basis. The reports go so fully into the details, and the Inspectors make it their business to discuss intelligently any difficulty—such as blue salt or sour oxide—that anyone having a file of these reports at hand is already provided with a practical treatise that affords enlightenment on almost every point in connection with the manufacture of sulphate of ammonia.

Last year's report (recently issued) contains incidental references to a matter that, under present circumstances, is of more than ordinary interest, and that is the waste and loss of ammoniacal liquor and ammonia. One Inspector is amazed to find the whole make of liquor is allowed to go to waste in certain small works. Gas engineers may well share his astonishment, in view of sulphate saleable at £13 a ton, and the well-known fact that ammonia utilization apparatus may be a paying investment in a concern using not more than 300 tons of coal per annum. Very often this is due to lack of proper professional advice. One is met with the apology, "We are too small to warrant the employment of a chemist or an engineer." But, as a matter of fact, any concern large enough to earn a profit will find a judicious outlay for competent advice to be an excellent method of increasing the dividends of the shareholders, or of adding to the stability and increasing the sales by reducing the working costs, and selling gas at a cheaper rate to the consumers. There are many small towns doing a 4 million annual output, at 4s. or 4s. 6d. per 1000 cubic feet, that could and would very well do 10 millions at 3s. 6d. An accurate chemical analysis of the flue gases from the retort-furnaces, or of the ammonia and other impurities at various points of the plant, need not entail a ruinous expenditure.

The waste of ammonia is not confined to small gas-works, but extends among those which ought to know better, and which would perhaps claim to work on modern lines. Another Inspector is impressed by the loss due to careless handling and exposure of ammoniacal liquor. As before, we may well be astonished, in view of the equally well-known fact that the greater part of the ammonia is present in the volatile form, and that, even at ordinary temperatures, very appreciable quantities may evaporate and go to waste in the atmosphere, instead of passing into the proper place in the sulphate house and in the annual revenue account.

These facts will appeal to practical chemical engineers at any time, but especially when gas engineers are bemoaning the increased cost of coal. A 10 per cent. advance at Midsummer, 1912, followed by one of nearly equal proportions this year, and without any improvement in quality, but rather the reverse, is raising serious apprehension as to the possibility of paying dividends without resorting to an increase in the price of gas. The redeeming feature has been the residuals. But there is obviously some uncertainty and limitation to the assistance that may be expected from this quarter. One of the best methods of meeting increased outlay is by the reduction of waste and improvement of working results; and therefore it may be interesting to follow out in some detail, and to extend, the hints comprised in the Alkali Inspector's report. The attention of these gentlemen is confined to the sulphate house and its accessories; but if they had the whole run of the works, I cannot but think they would be greatly impressed by the absence of anything like precision in regard to the removal and utilization of ammonia—even in works of some pretension to expert and scientific management, or where it is believed that the whole of the ammonia is practically turned to account.

Gas undertakings are under strict penalty in the matter of sulphuretted hydrogen, with the result that they invariably provide purifiers of ample capacity to ensure that the gas sent out is free from this impurity; and it is a most unusual and exceptional experience to hear of its presence. Possibly the fact that large purifiers afford economy in working may claim some of the credit. But this is really incidental; and the efficient removal of the objectionable impurity is undertaken without regard to expense. Let us imagine for a moment that there were equally stringent regulations in existence with regard to ammonia. One result would be that the returns for sulphate in the annual accounts would be much larger in many cases.

Complaints were made, and not without good reason, about the hardship of the sulphur compounds clauses—not so much because there was little or no profit to be gained by removing the sulphur, as on account of the erratic and uncertain nature of the impurity to be dealt with. After applying every care and precaution, it was difficult to comply with the regulations without great expense and some risk of nuisance; and evidence as to the necessity for their removal, as regarded from the users' point of view, was uncertain and contradictory. There are no difficulties of a corresponding nature in connection with ammonia. It can be removed with certainty, by methods quite practicable and simple in application. Its extraction is desirable in the interests of all parties concerned, in view of its energetic action on metals. If the gas is largely charged with ammonia, there will be frequent complaints of stiff main taps, and similar trouble with users' taps and hinge joints, to say nothing of the disadvantages attendant upon the absorption of ammonia in the station meter and in the gasholder tanks.

Directly we turn up comparative statistics on the subject, we are confronted with the difficulty that the manufacture of ammonia is only an incidental and side-issue in the manufacture of coal gas. The highest possible yield of ammonia is not compatible with a high yield and quality of gas. Indeed, there is good reason to believe that modern conditions of working are unfavourable rather than otherwise. Mr. Lewis T. Wright pointed out in 1888 that the maximum yield of ammonia was obtained with a make of about 10,000 cubic feet per ton; and the present idea is considerably in excess of this limit. In any case only a small proportion —sometimes not 10 per cent.—of the total nitrogen in the coal finds its way into the sulphate store. Gas coals as generally used show a content of 1 to 2 or 2¼ per cent. of nitrogen on ultimate analysis. About 50 lbs. of ammonia, or 200 lbs. of sulphate per ton of coal carbonized, is the equivalent of 2¼ per cent. of nitrogen—a quantity amply sufficient, at a net profit of 10s. per cwt., to pay the whole of the coal bill. But in actual practice, we find the make of liquor may be anything from 12 up to 40 gallons, the yield of sulphate 14 to 30 lbs., per ton of coal carbonized; and that if the income from ammonia pays 10 per cent. of the coal bill it is good working. Possibly the yield of liquor is an indefinite quantity, because it is not always the rule to correct the yield to the equivalent of 10 oz. strength. But no objection of this kind can apply to the make of sulphate, which is also free from the disturbance caused by the consumption of considerable quantities on the works, as may be the case with coke or tar. But even with the same class of coal, and apparently similar conditions of working, large variations in the yield are observable. It is impossible to avoid the conclusion that the yield is affected as much by the personality of the engineer as by anything else, and that, after allowing for different quality of material and conditions of working, much depends on the care and skill applied to the manipulation of the washers and scrubbers, the storing, and otherwise dealing with the liquor, and the working of the sulphate plant.

We are not dealing with a trifling question of a decimal point or two per 1000 cubic feet of gas made, but with one that may have an important effect upon the selling price. If we leave the percentage or weight, and consider the net cash receipts per ton of coal, they will be observed to be anything from 7d. up to 4s. 2d., and neither the maxima nor the minima will favour particular kinds of coal. It does not necessarily follow that because the annual statistics figure-out well up to the average obtained in other works of similar size, there is no loss or waste. A general comparison is apt to mislead, unless we have proof of the accuracy of the standard. I know from experience, in regard to gas-works where the statistics have for years been passed as satisfactory by experienced professional accountants, that a general whip-up has improved the ammonia results 10 per cent.

Some very general sources of waste, in addition to those mentioned by the Inspectors, are the passing on with the gas to the purifiers, unintentional and unknown leakages of liquor, the fume pipe from the saturator, and the effluent from the boiler or still. There are many works where these points receive quite adequate attention; but there are others where the whole process of absorbing and utilizing ammonia is conducted in a rough and ready manner, with no testing other than an occasional strip of litmus paper. This applies specially to gas-works that, to use the general expression, are too small to warrant the employment of skilled advice, but by no means entirely. We often find that, while every care is taken with the retorts, the purifiers, and the gasholder capacity, the washers and scrubbers are neglected, and that the engineer has too many other irons in the fire to give proper attention to the ammonia. The small proportion of this impurity, regarded as a percentage of the make of gas, is also misleading. The total proportion will not be more than 3 or 4 grains per cubic foot of gas. Yet I have known an engineer to suppose that because a test at the inlet to the purifiers showed about 0·5 grain per cubic foot, he was practically taking out the whole, or, at any rate, only leaving a small quantity sufficient to keep the oxide in an alkaline state, and it was difficult to persuade him he was losing and wasting nearly 20 per cent. of the whole.

The loss of ammonia, too, through leakage of liquor and soakage into the ground is much more general than may be supposed. I have heard the contention that the absence of complaint in respect to adjacent drains and water courses may be taken as a proof that the storage tanks and connections are practically sound. But I have known a loss of nearly 50 per cent. of the whole make to go on for years without evidence of its existence, and it was only discovered when a contractor bought up the whole make of liquor for a twelve month on the basis of the coal tonnage. In another gas-works, situated well inside a town and surrounded by cottages and wells, the returns for liquor had been abnormally low for years. A stock of 30,000 gallons was sold to a contractor, and for some reason there was a delay in loading; and when he sent for the agreed quantity, nothing like 30,000 gallons could be found. This led to inquiries that unearthed the existence of a large crack or fissure in the side of the tank near the bottom. Later, a boring was made upon the premises for the purpose of getting a water supply, and water pumped up from a depth of over 50 feet was condemned by an expert, as containing too much ammonia to be fit for use in the boiler. These experiences suggest that it might be worth while to exploit the site of many gas-works of fifty years' or longer standing, at any rate for water

to be used in the washers or scrubbers, when sulphate is up to £13 per ton.

The earliest tanks for storing liquor, built perhaps eighty years ago, were constructed without special care as to soundness. The liquor was regarded as being of little or no value, and, so far from a little leakage being an objection, it was welcomed, so long as there was no trouble by the pollution of neighbouring wells or water courses. But in nine works out of ten it will be found that a discarded holder tank has been utilized for a liquor store-tank, and that it has been tacitly assumed that a tank that gave no trouble when used for a gasholder, is good enough for liquor. But very few of the old-pattern brick and puddle tanks, built before reliable Portland cement was on the market, can claim to be bottle-tight. In many of them the necessity for an overflow was not experienced, and the natural rainfall had to be supplemented in other ways from time to time. The process of dismantling the old holder, removing the channel guides, &c., carried out with no special care, did not improve matters. The upper part was cut down to 3 feet or so below the ground level to admit of a roof or covering, sometimes carried on arches, sometimes on the flat, and supported by joists or girders. No particular trouble was taken to see that the floor and the top of the wall were a sound, tight fit, and the same as regards the inlet pipes, which may, for convenience in draining off drip-boxes or purifiers below ground, be carried at a greater depth. It is the exception rather than otherwise to find that such a tank has at any time, either as a holder tank or as a liquor well, been tested for soundness. In many small works it is the practice, for convenience of working, to wait till the well is full, and then "make up" the stock of liquor. And not infrequently it happens that, when the well is nearly full, the saturator is found to be out of order, or there is a delay in getting in a supply of acid. Meanwhile, there is considerable loss of liquor from the upper part of the tank. All this may sound like romancing, but it is founded on actual fact. A strong cast-iron tank would, in many cases, save its cost over and over again. And when a discarded gasholder tank is used, it should be carefully tested for soundness.

The tip-bucket on the top of the scrubber, or other distributing arrangement, may be an important and unsuspected source of waste. Very commonly it is quite open or unprotected, and a continual supply of liquor is flowing through it and subject to considerable agitation. This applies particularly to the No. 1 or the strong liquor scrubber; but we must not conclude that weak liquors can be freely exposed without loss. Also there is nothing out of the common in a seal-box entirely open or very inefficiently covered, and that in spite of a decided ammoniacal odour. In this case there is not only loss, but risk of injury to any valves or wrought-iron work in the neighbourhood, and of dust finding its way into the tar well, where it accumulates as a troublesome sediment, and occasions great inconvenience by getting into the valves of the pumps. The overhead store tank for supplying the sulphate still by gravitation, or else for loading into railway tank-waggons, may also be very indifferently covered or not covered at all.

It is a singular fact that, in whatever form the ammonia is wasted, there is consequential positive damage in some form or other. Uncovered tanks or seal-pots usually mean leaky bye-pass valves; and, where there is a strong ammoniacal odour, the well-known gassy smell is within hailing distance. If any quantity of ammonia goes on to the dry purifiers, the station meter, or the gasholder tank, there is sure to be incidental trouble. During hot weather at any rate, ammoniacal odours add to the discomfort of the workmen and the risk of nuisance in handling spent material, while the importance of the gasholder lifts and other parts is so evident, that they cannot be too strictly protected from prejudicial influences. A gasholder will keep sound and in good order for a longer period if working in clear water, than if it is exposed to a liquid that is, to all intents and purposes, a 1° or 2° ammoniacal liquor.

(To be concluded.)

LIGHTING OF SCHOOLS.

THE report made to the Education Department of the Cheshire County Council by the Chief School Medical Officer for 1912 (Dr. Meredith Young) contains the following remarks by Dr. CAMERON GIBSON on the lighting of school-rooms. They embody the results of an inquiry carried out by him at the suggestion of Dr. Young.

The instrument used was Bishop Harman's photometer, in which the illumination at the place to be tested is matched by that from a standard candle, the distance of which from the illuminated object can be varied and measured by mechanical means. The illumination is then read off in foot-candles. Further, Bishop Harman suggests that the minimum illumination advisable is 9 foot-candles for daylight or 3 foot-candles for artificial light, as measured by his instrument.

The intensity of daylight varies very much according to the state of the sky, the hour of the day, and the season; so that in order to compare the natural illumination in one room with that in another, one required some measure of the intensity of the daylight that obtained outside at the time the light inside the room was estimated. This is accomplished by means of a photographic exposure meter, in which the time taken for the light to darken a piece of sensitive paper to a standard tint is noted; and as the quantity of light that must be absorbed in order to produce the definite amount of chemical change corresponding to the change in colour is constant, the length of time taken is an inverse measure of the brilliancy of the light. That is to say, if, when it takes 50 seconds out in the open to darken the paper to the standard tint, the lighting at a certain point in a room is 12 foot-candles, then, when on another occasion it takes 100 seconds outside to darken the paper as before, the illumination at the same point in the room should be found to be 6 foot-candles. This, however, is only approximately true, as any point in a room is not lit by the whole sky, but by a small part of it, the brilliancy of which may differ very much from the general brilliancy.

I have stated above that a minimum daylight illumination of 9 foot-candles has been laid down as being desirable. In order to decide whether any room is well lit on this basis, one must premise a certain brilliancy of outside daylight at which this figure of 9 foot-candles must be attained at the working points within the room. In the middle of the day, with the air clear, the winter sun may take 50 seconds to darken the sensitive paper to the standard tint; while, if the sun be obscured by clouds, the time taken may be anything up to 300 seconds, under ordinary conditions of weather. So that one can take as a low standard that the illumination of a room should satisfy requirements with outside light having an actinometer value of 50 seconds—that is to say, weak wintry sunshine. Owing to the variation in brilliancy of different parts of the sky, the lighting would need to be measured on several occasions. Many of the schoolrooms examined could not be classed as well lit, but indeed are frankly bad.

The ratio of the floor area to the glazed area of the windows varied from between 6 and 7 to 1 in the newer schools, to between 10 and 13½ to 1 in the older ones. One usually finds, in these latter rooms, that only a comparatively small portion of the floor

TABLE *giving Results of Dr. Gibson's Investigations on Artificial Lighting by Gas.*

School and Room.	Source of Light.	Height in Feet of Light from Floor.	Area of Floor, in Square Feet.	Estimated Consumption of Gas in Cubic Feet per 100 Square Feet of Floor per Hour.	Desk Illumination (Foot-Candles).					Blackboard Illumination.
					Max.	Min.	Aver.	Diversity Co-efficient.†	No. of Places with Illumination under 3.	
Sandbach Technical—										
Needlework room	2 batswing burners, 2 upright incandescent, 4 inverted incandescent	5¼	338	10	7	(½)	3·00	14	12	(½)
Small art room	4 upright incandescent	9¼	283	6	3·5	(½)	1·75	7	all but 2	2
Large room, North portion	3 upright incandescent	7¾	356	3	6	1	3·22	6	11	2·75
Committee room	8 batswing burners	6½	512	8	3·5	1	2·70	3·50	29	4
Nantwich Technical—										
Room 7	5 upright incandescent	9 and 7	430	5	8	2·75	5·10	2·90	1	3
Room 1	4 upright incandescent	9	398	4	12	2·75	7·00	4·40	1	3·75
L.C.C. School, Barnsbury*	upright incandescent	?	540	2·6	4·1	2·40	3·12	1·71	?	2·00
East Ham School, Hartley Avenue*	inverted	?	634	2·37	6·0	2·40	4·21	2·50	?	2·60

* The last two are taken as typical examples of satisfactory gas illumination from tables in an article by Mr. F. W. Goodenough in the "Illuminating Engineer" for February, 1911

† Diversity co-efficient is the ratio between the maximum and minimum illuminations.

is utilized for the children, as the desks are crowded into the part which is well lit. For instance, in one room, with a floor to glass ratio of 13½ in. to 1 in., 53 children were crowded on to a floor space of 168 square feet, next to the windows, with the result that the average illumination of the desks was quite good. But this crowding is very reprehensible for other reasons.

The width of the room, from the window wall, in association with the height of the window, is another very important factor. With windows 12 feet high, the range of good illumination seldom extends farther than 18 to 20 feet from the window. One consequently finds that in the newer classrooms, with sufficient window area, and a window height of 12 feet or a little more, but a width of floor of 25 feet, the file of desks farthest from the windows, and even sometimes two files, are empty of children, owing to their poverty of lighting. The farthest desks receive light from the lowest fourth only of the sky, part of which is likely to be obstructed by buildings or trees; and also the light necessarily falls at a very low angle, and is more spent in useless reflection than in illumination. The lower the window, the less the width of floor that can be well illuminated. Occasionally one finds that the passage of light through the windows is obstructed by an obscuring of the panes or by curtains.

The lower limit of the glazing or height of the sill is as much as 5 feet above the floor in some infant-rooms. The part of the floor next to the window wall cannot then be well utilized, as the lighting is defective. Doubtless the colouring of the walls, ceiling, &c., has an effect on the illumination of the room; but this could not be clearly traced, owing to the largeness of the other factors.

Even in a well-lit room, the disposition of the desks so that the children sit with their backs to the light may reduce the illumination on the books to much below the minimum desirable. When measured, the light on the desk in the shadow of the child's head was found to be from one-third to one-ninth of what it was clear of the shadow. The position of the blackboard is also of great importance.

CALORIFIC STANDARDS FOR GAS.

Examples from the United States and Elsewhere.

In a preceding issue of the "JOURNAL" [*ante*, p. 102], an abstract was given of an important report on an investigation into the conditions governing the choice of a proper standard of quality for artificial gas, conducted by a Joint Committee on Calorimetry composed of representatives of the Public Service Commission and certain gas companies in the Second Public Service District of the State of New York; the object being, it may be remembered, to fix a calorific standard for gas. One of the appendices to the report contained particulars in regard to the standards in force in various places in the States and in Europe; and these it may be of interest to reproduce.

It appears that Wisconsin, which was the pioneer in the establishment of a State standard of heating value, conducted, through the Wisconsin Railroad Commission, a series of tests before the adoption of the requirement now in force. These tests, however, did not cover a sufficient period of time or an adequate variety of conditions to be conclusive. At the present time, heating-value requirements are in force in five States and in some thirty-one cities, as follows:

States.

	Monthly Average.		Minimum.
Wisconsin	600 B.Th.U.	gross	550 B.Th.U.
New Jersey	600 ,,	,,	550 ,,
Nevada	550 ,,	,,	500 ,,
Washington	600 ,,	total	550 ,,
Indiana	600 B.Th.U.		

Cities.

	B.Th.U.		B.Th.U.
Aurora (Ill.)	600 gross	Elyria (O.)	600 heat units
Birmingham (Ala.)	575 ,,	Freeport (Ill.)	600 monthly average
Cedar Rapids (Ia.)	600	Freeport (Ill.)	550 minimum
Chicago (Ill.)	600 gross	Helena (Mont.)	500
Dallas (Tex.)	650	Kankakee (Ill.)	600 heat units
Detroit (Mich.)	600 gross	Ottawa (Ill.)	600
Elgin (Ill.)	600 net	Sault St. Marie (Mich.)	500
Fort Wayne (Ind.)	550	Port Huron (Mich.)	600 gross
Indianapolis (Ind.)	600	Stockton (Cal.)	600 ,, mon. average
Jackson (Mich.)	600	Minneapolis (Min.)	600
Joliet (Ill.)	600 heat units	Minneapolis (Min.)	550 daily min.
Kalamazoo (Mich.)	600 gross	Oakland (Cal.)	600
Lancing (Mich.)	600 (low value)	Omaha (Neb.)	600 net
Lincoln (Neb.)	625	San Francisco (Cal.)	600
Los Angeles (Cal.)	600 gross	Springfield (Ill.)	650
Milwaukee (Wis.)	635 ,,		
Adrian (Mich.)	600 average		
Elkhart (Ind.)	600		

It is pointed out that in 1906 the calorific standard was adopted in England for the Tottenham Gas Company, and it was fixed by agreement; but the Gaslight and Coke Company was the first to have the heat-unit test statutorily applied to town gas—the figures being set at approximately 500 B.Th.U. net, with a minimum of 450 B.Th.U.

Paris has adopted a calorific standard of 528 B.Th.U. net, and abandoned photometric requirements. The same standard holds in Rheims. Marseilles has adopted 551; Milan, 573 B.Th.U.

In 1909, German chemists concluded that they ought to have a calorific test, and that the figures should be set at 543 B.Th.U. gross, with a minimum of 522 B.Th.U.—these results to apply to tests made at the works. There is even yet no generally accepted standard of calorific value in Germany, although tests have been regularly made for at least seven years in Berlin, Magdeburg, Bonn, and Breslau. Zurich was also testing for calorific value at least five years ago.

A member of the Committee ascertained from personal observation that many Continental cities do not even maintain photometric apparatus for testing gas. Included in this number are Paris, Brussels, Ghent, Bruges, Nuremberg, Stettin, Berlin, Charlottenburg, Warsaw, and Zurich. No attention is paid to candle power. Another authority, from personal inquiry and observation, confirmed this tendency, by information derived within six months, that the same conditions may be found in Austria and Austria-Hungary, as well as in Germany and other Continental countries. In these countries, it is customary to correct the gas volume to 0° C. (32° Fahr.) and 760 mm. (30 in. barometer). The correction to 32° Fahr., instead of 60° Fahr. used in the United States and by the Committee, means that the standard abroad is actually over 5 per cent. lower than the figures quoted above would indicate. For example, a German gas consumer receiving 543 B.Th.U. gross per cubic foot of gas is actually receiving not more than 516 B.Th.U. when United States methods of measurements are followed.

In South America, Colombo has had a heat-unit standard of 400 B.Th.U. for about five years; and in Buenos Ayres it is required that the net calorific value of gas shall not be less than 539 B.Th.U.

It will be seen from the preceding figures that the calorific power requirements in Great Britain, on the Continent, and in South America are generally lower than those in the United States, due, the Committee states, to a recognition of the economic advantages of permitting the use of unenriched coal gas manufactured from such grades of coal as were available.

The Committee consider that the standards which have in the past been adopted in America are in most cases in excess of what should be required. They were usually set arbitrarily and without thorough investigation; and it is inconceivable that they would have been so fixed with present available raw materials. A table is given which shows the monthly averages of the heating power of gas, enriched to meet the present illuminating power standards, to be as low as 584 B.Th.U., and showing the monthly averages of the heating power of unenriched coal gas—manufactured, however, from the highest grades of coal—as low as 556 B.Th.U. These are not individual readings, but are averages for entire months.

SALINE CORROSION OF GAS-RETORTS.

Certain kinds of coal corrode the sides of gas-retorts and coke-ovens; and Herr Zinck, of Halberstadt, recently drew the attention of the Association of Gas Engineers of Saxony and Thuringia to the subject. He calls this action of coal "saline corrosion," because he considers it to be due to chloride of sodium. The salts of soda are generally the most active agents. Heat decomposes them into an acid element and a basic element. The former combines with the free ammonia existing in the gas, and appears in the ammoniacal liquor; while the basic element (sodium hydrate) is evaporated at a higher temperature, and combines with the surface of the brick to form a coating on it. This coating is sensitive to the variations of temperature, and cracks, so that further quantities of hydrate fumes can enter. Owing to the cracks and the greater fusibility of the coating, the bricks acquire an inflated appearance, which is a sufficient sign of the damage. The varieties of coal which have this action are, however, few in number.

The proportion of silica decreases, in the decomposed part of the retort, from 61·20 to 57·76 per cent., and even to 55·42 per cent. in the part which melts and runs. On the other hand, the alkali increases from 1·22 to 4·63 per cent. The observations made at a coke-works demonstrated that a proportion of 0·143 per cent. of salt in the water employed to wash coal ruins a retort in three years; one-fourth of this proportion prevents the preservation of a refractory brick in good condition for more than five years; while its percentage of alkali increases from 1·10 to 1·80 on the surface. As soon as a coating is formed on a retort, charging and drawing make the surface crack, and this helps to propagate the evil.

Herr Zinck related the results of his experiments with inclined retorts, where corrosion of the sides was so great that drawing took from 40 to 50 minutes. A kind of skin formed on the surface, and graphite accumulated underneath. The builders of the retorts maintained that it was saline corrosion, for which they were not responsible; but the managers of the works would not admit this, as the surface had only the characteristic inflation. The question was therefore submitted to the chemists. The result of the investigation was that the materials were found to be not equally refractory in all parts, as they should be; and the builders entirely reconstructed the interior sides.

The Carlsruhe Central Research Department has ascribed the

corrosion to the high temperature produced by the combustion of graphite in the time between the drawing and charging of the retorts. The result was a fusion causing the formation of a crust, which subsequently peeled off under the influence of variations of temperature. This explanation was confirmed by the identity in chemical composition of the superficial crust and the centre of the bricks. It was also found that the damaged parts had been overheated. The deposit of graphite appears to be largely due to the action of the air. When there are cracks by which air can enter, graphite forms; but with 60 per cent. of nitrogen in the gas, there is no deposit. The best way to prevent the corrosion of retorts by salt is to employ good building materials, as there is practically no coal which does not contain from 200 to 1000 grammes of chloride of sodium per ton.

IMPROPER LIGHTING AND EYE-STRAIN.

In connection with the remarks made at the recent Medical Congress on the effect of artificial light on the eyesight, as noticed in our editorial columns on the 19th ult. (p. 483), it may be of interest to reproduce the following extracts from an address to the New York Illuminating Engineering Society, by Dr. Ellice M. Alger, Professor of Diseases of the Eye in the New York Post-Graduate Medical School, on the results of eye-strain due to improper conditions of lighting.

Eye-strain is the common expression for that rather comprehensive group of symptoms which occur from abnormal ocular fatigue. It results from compelling eyes to do work which is beyond their physiological capacity. Things close at hand are seen by a muscular effort of focussing which, when long continued, produces a normal fatigue, and requires a definite period of recuperation. If the eyes tire sooner than they should because of some intrinsic weakness of ciliary muscles or because of a handicap imposed by astigmatism or increasing years, the fatigue is apt to manifest itself not only by defective vision but by pain; and we speak of the condition as an "accommodative asthenopia." The eye likewise sees things through the effect of light falling on a sensitive retina. If this light be over-bright, or if the retina, by reason of over-exposure or disease, is hypersensitive, the result is the disturbance of vision and pain which we call "retinal asthenopia."

The results of eye-strain are manifold and affect no two people exactly alike. They include pains in the eyes and many functional defects of vision, and quite possibly often result in organic eye disease as well. They cause 80 per cent. of the chronic headaches. They result often in functional disturbances of other organs, and in conditions of general nervous exhaustion and irritability. While most of the symptoms that result from eye-strain are of the accommodative sort, these are all capable of aggravation by improper lighting; and there are so many that are caused directly in this way, that I shall invite your attention for a time to the relation between eye-strain and illumination.

Individuals Differ Widely.

In studying this relation, it must be remembered that there are few exact standards of ocular capacity. The average individual can see objects of a definite size at a definite distance, and this average is taken as a standard; but there are many who fall below it, without obvious cause, and many who are far above the average. The sensitiveness to light likewise varies widely in different individuals—both ability to see distinctly by faulty light and ability to work without exhaustion in strong light.

Light is the reaction excited in the retina by the impact of certain vibrations or waves in the ether which cause different sensations according as they are longer or shorter. The long ones give the sensation of red light, while as they get shorter and shorter one may see in succession all the colours of the visible spectrum. The mixture of all these wave-lengths together produces the sensation of white light. But the visible spectrum does not include all the waves by any means. There are longer waves than the red which cannot be seen but can be felt as heat, and shorter ones than the violet which have a very active chemical effect. It must be remembered, too, that both these quantities exist in the visible spectrum—the heating effects predominating at the red end, while the violet end approaches the ultra-violet in its chemical activity. This enables one to explain some of the untoward effects of daylight on the eyes, even though daylight affords the best illumination for ordinary purposes.

Chemical Activity Effects.

Many of the effects of sunlight which were once attributed to heat are now known to be due to chemical activity. In temperate climes, one suffers more or less from glare and burn from direct or reflected sunlight; and by common consent a good north light is taken as the standard of ideal illumination—being the steadiest, the pleasantest to the eyes, the best diffused, causing the fewest shadows, and affecting colour values least.

It has been shown by experiment that the light which gives the maximum of illumination with the minimum of irritation of the eye is composed of the yellowish rays from the middle of the spectrum. For this reason the old-fashioned candle and kerosene lights have never gone entirely out of fashion. But most of the more recent artificial lights, whether gas or electric, contain a much higher proportion of the short violet or actinic rays, and some of them contain many of the ultra-violet rays as well. When unshaded, their chemical activity is so great that they can be used for various therapeutic purposes. Prolonged exposure to the electric arc light sometimes produces an intense conjunctivitis with contraction of the pupils and erosions of the cornea, which fortunately generally yield readily to treatment. Nearly everybody has experienced the discomfort and premature fatigue that comes from reading by unshaded incandescent lights. Even if they do not actually produce inflammatory changes themselves, they certainly render those already present decidedly less tolerable.

It is quite possible, however, that the delayed actinic effects of light, whether natural or artificial, are much more serious. The ultra-violet rays are arrested by ordinary glass, and in the eye by the tissues of the cornea and lens, so that the deeper structures of the eye escape harm; but there is strong reason to suspect that their constant absorption by the lens may be one of the causes of cataract.

Even if the ultra-violet rays do not reach the deeper structures of the eye, one must not forget that the shorter waves of the visible spectrum have decided actinic properties. Many people have had their eyes permanently ruined by incautious watching of an eclipse, and similar damage sometimes follows exposure to electric flashes and even too long exposure to the arc light. In such cases, the light is condensed on the surface of the retina, resulting in local inflammation and degeneration—that particular spot becoming permanently blind.

Artificial Light *v.* North Light.

North light is soft and even and well diffused, so that it causes a minimum of shadows. Artificial light to give anything like the same amount of illumination must be much more concentrated and intense. Now the human eye, even in natural light, has to adapt itself to so many variations of intensity and dimness, that it has developed a very beautiful mechanism for regulating the amount of light admitted to the retina. When the light is dim, the pupil dilates; and when it is bright, it contracts sharply. A sudden very bright light causes pain, not because the retina hurts, but because of this sudden extreme muscular contraction of the iris. Constant exposure to bright light necessitates constant muscular contraction, and engenders in many people premature fatigue. Still more tiresome and painful are the rapid dilation and contraction of the pupil that result from the varying intensity of a flickering light. Furthermore, intense and long-continued exposure to bright light causes retinal exhaustion, and the retina is capable of reacting only to powerful stimulation. In other words, that retina becomes for the time being blind except in the brightest of lights. Every one has experienced the comparative blindness caused by going from bright sunlight into a dimly-lighted room. It is a common experience to have workmen insist on having as intense a light as possible, because they have temporarily so blunted their retinal sensitiveness that they are helpless without it; and it is generally the hardest kind of a task to convince them that even if they suffer no harm from the glare they cannot possibly work as long without fatigue.

Daylight has a vast volume, and is diffused, so that objects get light from every side, and all shadows are reduced to a minimum. Artificial light can hardly be expected to secure thorough diffusion and more than comparative freedom from shadows; but in many industries almost no attention has been paid to this point. And yet it is very important, for it has been shown that retinal anesthesia and deep shadows resulting from poor artificial lighting are potent factors in causing industrial accidents.

Most Accidents in Winter.

The records of some 8000 manufacturing plants over a period of three years showed a regular minimum of accidents during July and August, which gradually increased to a maximum in the dark winter months. The influence of daylight in preventing accident was much more evident in occupations which require not so much bright light as diffused light without shadows over large areas—as in the building trades, for instance. Indoor workers so often suffer accident from too much as from too little light.

Exact photometric measurements often show that the light of ordinary incandescent lamps concentrated at the cutting point of a tool or a work-bench is often several times the intensity of daylight. But the eye adapts itself to this intensity; and when the workman turns from his over-lighted work, perhaps in a room full of moving machinery, he is practically blind. What is needed, from the point not only of safety but of health and comfort, is much less intensity and much better diffusion of light. This applies to all walks of life. We have all become accustomed to using far more intense light than we need.

One can measure the amount of illumination by photometers, which are much more accurate and dependable than the human eye; but, after all is said and done, the eye is one of the best of photometers, if one is careful not to injure it in the process, since it is upon its adaptability to that eye that all artificial lights must stand or fall. One should begin with a low illumination, and gradually increase it till a point is reached when further increase ceases to improve the details of the work in hand. Beyond this an additional light is both unnecessary and physiological extravagance.

Eye-Strain Leads to Poor Health.

Abnormal fatigue is admittedly one of the greatest predisposing causes to most diseases, be they physical or mental; and though the part played by bad lighting is perhaps not clearly cut, it is beyond doubt that in most factories, schools, and offices the eyes must be used constantly for work of a character they were never intended for. The result, even in normal eyes, is a muscular and nervous fatigue which is measurably increased by both over and under lighting. The first engenders fatigue from retinal exhaustion and pupillary spasm, while the second results in the strain that follows sharp focussing and constant attention. It is quite possible that eye-strain and the constant exposure to intense light of short wave-length may be predisposing factors to the neurasthenia from which our garment makers admittedly suffer.

The arrangement of lights as well as their composition and intensity is of importance. It is well known how uncomfortable it is, and how much it interferes with clear vision, to have a bright light shining directly into the eyes; and lights which enter the eye from below are much more annoying than those from above. And yet how often are machines so placed that the operator has to face a window or a light. So far as possible, light should fall from above, behind, and to one side. The light should be sufficient for the work in hand, should throw no shadows on the work, and should be reflected not into the eyes of the workers but to one side. When it comes to the arrangement of light for many workers in a factory or school, the problem is very much more difficult, and presents many technical details, which must be left in the hands of the illuminating engineer.

Bad Light More Expensive Than Good Light.

Even when estimated by its actual cost in money, bad lighting is often more expensive than good; but from the standpoint of efficiency, there is no comparison. Bad lighting undoubtedly causes unnecessary strain of the eyes, and consequent premature muscular fatigue. It compels closer and more constant attention to the details of work, so that tasks which should be done almost automatically and without mental effort are done consciously. Under such circumstances, the output of each individual is manifestly less than it should be; there is a larger percentage of mistakes and material spoiled; and the number of accidents, large and small, is vastly increased. Even under the best of conditions, the extreme subdivision of factory work, with its consequent monotony, largely destroys the pleasure of work; but bad eyes, poor lighting, and long hours are important factors in the industrial discontent of the day.

It goes without saying that any system of scientific shop management worthy of the name implies a good lighting system as one of the first requisites; but as yet opinions vary widely as to just what this means. It is possible to regulate the colour and composition of the light that enters the eyes by the interposition of screens or shades which shall absorb the rays one does not wish to use, or by having it reflected from suitable coloured surfaces. The volume and intensity of light can be regulated by increasing or diminishing the number of units, and by diffusing it with frosted shades, or by reflecting it from rough surfaces. But while the experts are agreed on the principles involved, they do not agree entirely on the details. The human eye is flexible enough to adapt itself to very wide variations in illumination; but there must be comparatively narrow limits within which the greatest efficiency may be reached. Quite possibly different industries may require entirely different types of illumination; and while these may be worked out in detail in the laboratory, they must all be subjected to the final test in the shop or school.

State Must Control Conditions.

Everyone admits to-day that the State must control factory conditions so far as they affect the health and well-being of employees; and many attempts are being made to deal with the subject of illumination by law. It is an extremely difficult subject to handle in this way. Even the experts are not agreed on many important points. What would be good lighting in one industry might be the worse possible in another. To make drastic regulations in the present state of the art would often involve manufacturers in great expense in changing their light equipment without any guarantee that it would be permanently satisfactory.

After all, good lighting is essential to the efficiency of both employer and employed; and a judicious campaign of education will make them both appreciate it. Then, too, there are numerous large and powerful corporations engaged in various branches of the lighting industry; and so there is little danger that the subject will be allowed to be forgotten either by consumers or legislators.

HOME EXPERIMENTS IN ILLUMINATION FROM LARGE-AREA LIGHT SOURCES.

By Dr. Herbert E. Ives, Physicist in the Laboratory of the United Gas Improvement Company, Philadelphia.

In a paper presented at a meeting of the Philadelphia Section of the Illuminating Engineering Society of New York, the author described some experiments he had carried out with the consideration of efficiency subordinated. The problem before him was to obtain a pleasing, satisfactory illumination, regardless of cost or of established ideas. Chief attention was paid to direction, diffusion, and absence of glare. Means of measuring these qualities not being established, the criterion adopted was the writer's judgment. An analysis of light sources is made on the basis of size, intrinsic brilliancy, direction of light, and whether the principal source is visible or concealed. The text of the paper, with the author's diagrams, was published in the "Transactions" of the Society for June, and from it the following extracts were made. It may be remembered that Dr. Ives has devised an artificial daylight producer, which was described by Mr. R. ffrench Pierce in the "Journal" for the 5th ult. (p. 366).

Introduction.

There is an old saying that "shoemakers' children go barefoot," and it is a matter of common observation that illuminating engineers have little time to study the lighting of their own homes. This should not be, of course, for a "doctor should have faith in his own medicine." But over and above such considerations is the fact that the least cultivated, but probably most important, field for good work in illumination is the lighting of the home. It is an almost every-day experience for us to see houses which are beautiful by day, but at night are actual atrocities—monuments to a lack of the most elementary conception of the lighting problem on the part of the architect.

It was in the effort to light my own home satisfactorily that the experiments to be described were begun. As time went on, however, the problems studied became somewhat varied, until lately attempts to copy daylight distribution of illumination have occupied most of my attention. The matter which follows is somewhat rambling, and the experiments somewhat incomplete, for reasons given; but as the next stage of the work may be delayed for some time, it was thought well to publish this much, if for no other reason than for the discussion which may result. Out of this study have come some novel lighting devices and some new lighting schemes which are thought worth recording. Also, in the course of the work brightness measurements of different conditions were made which bring out points of interest.

A great advantage of using one's own house as an illumination laboratory is that one can live with the lighting system and learn how it wears, as the various normal activities are carried on at their normal times. The disadvantages are several. A considerable one is that it is difficult, and often impossible, to make changes in the positions of the outlets. A special house with furniture complete would possibly be the right thing for a study of this kind; but even this would labour under the disadvantage that one would be likely not to feel "at home," and would not be apt to live in it long enough to determine how it wore.

A Characteristic of Home Lighting.

A characteristic of home lighting which makes it well worth studying by a lighting company is that efficiency counts for little Furniture and pictures are not bought for their cheapness. Neither should light be; nor will it when the public are better educated in the use of light and in its remarkable decorative possibilities. In domestic lighting the real problem is to obtain a pleasant illumination effect, almost without regard to cost. In the experiments here described, no attention whatever has been paid to efficiency. The author has put himself in the position of a householder who demands certain lighting effects and is willing to pay for satisfaction. In fact, he believes that many possible lighting schemes have not been tried at all—notably copies of daylight distribution—because the illuminating engineer has been apt to think too quickly of efficiency. He has been an engineer before being an artist; whereas the more fruitful procedure is first to obtain the desired effect and then count the cost.

Measurements and Measuring Instruments.

This paper is to be comparatively free from foot-candle values, watts per square foot, and the like. The chief points aimed at are diffusion, proper direction, freedom from excessive contrast

and glare, a pleasant, non-fatiguing quality, and good appearance. How can these be measured? In the writer's opinion, the only reliable, sensitive instrument is the experienced eye of one who has observed and thought about illumination for a period of years. We have all of us noticed how sensitive we have become to exposed light sources. Formerly they irritated us, to be sure; but we did not know the cause. Now we choose our position with care, shield our eyes with our hands, and in other ways give testimony to the vastly increased sensitiveness of our seeing mechanism. Meanwhile, it remains a sad fact that we have generally available no method of measuring lighting conditions which will do more than distinguish between two so extreme in quality that a mere casual glance will tell which is good and which bad. Until we are better off in this respect, the trained eye must be encouraged as the best we have. It is worse than useless to make measurements of factors which are not the ones really vital. If home illumination demands diffusion and a feeling of comfort, metre-candles illumination on the working plane has very little to do with the problem. It must be borne in mind that measurements are of no value unless they record conditions of which the qualities are proved by experience. Experience can never be dispensed with; it must be called upon sooner or later. This paper deals with lighting schemes of which the measuring instrument at present is experience. Recognizing this fact, I have outspokenly given here as the final criticism my own judgment of the success of an installation. In all cases, however, I have had as many comments and suggestions from others as I could obtain.

Direction, Diffusion, Glare, and Contrast.

One peculiarity of daylight illumination from windows is its direction. Most artificial systems cast the light downward from a point near the centre of the ceiling. There then occurs in changing from day to artificial light a 90° rotation of shadows. By day they are long and sweep across the room; by night they are short, or completely covered by the shadow-casting object. As far as direction is concerned, side wall brackets, floor standards, or table-lamps on side tables approximate more nearly to window conditions.

Diffusion of light with soft shadows, as is well known, is most perfectly brought about by the use of a large area of light source, and is one of the chief merits of the "indirect" system. A certain degree of diffusion may also be obtained by a multiplicity of light sources, though this is apt to give merely a multiplicity of sharply defined shadows, instead of the soft shadows of the large source. The ordinary window, with its area of 5 or 6 square feet, gives a far better degree of diffusion than most artificial schemes. Another factor in diffusion is the colour of the light. Blue light diffuses better than yellow. It is therefore possible that daylight is inherently apt to be better diffused than yellow artificial light.

In regard to contrast and glare, it is well to bear in mind some numerical data. A Welsbach mantle has an intrinsic brilliancy of 35-candle power per square inch; a tungsten filament, about 1000; a patch of sky, about 2 to 3. For the same intensity of illumination therefore—that is, the same general brightness of illuminated objects—the physical contrast between the brightness of the illuminated objects and the light sources themselves will be from ten times to hundreds of times greater with visible "direct" artificial light than with daylight. If the light sources are concealed, this contrast may be avoided; but it occurs again to a disturbing degree if specularly reflecting surfaces are present. These reflect images of the light sources with about 1-10th or 1-20th of the intrinsic brightness of the parent source.

Classification of Light Sources.

The common classification of light sources into direct, indirect, and semi-indirect, while convenient, is by no means a complete analysis. The true classification is on the basis of the size of the source, and whether it is concealed or visible. The earlier sources, such as the gas-flame and the carbon filament, were small sources of relatively high intrinsic brilliancy. From them we have been working towards large sources of lower intrinsic brilliancy. The fact that some of these are large areas of diffusely reflecting ceiling, and that others are large areas of diffusely transmitting glassware, is of no great significance. It is of significance that the light source is of large extent, and of low intrinsic brilliancy. It is also of significance that in each of these cases ("indirect" and "semi-indirect") the principal light source is visible. By "principal light source," I mean the source that furnishes the greater part of the light which falls on floor, furniture, and working plane. It is also of great importance that, as ordinarily worked out, in "indirect" and "semi-indirect" installations the light source is of necessity the brightest object in the field of view. Therefore the indirect and the semi-indirect systems sift down to this—that the unconcealed light source is made as large as possible in the attempt to make its intrinsic brilliancy low and bearable. Incidentally, this causes great diffusion of light and soft shadows.

In some forms of "direct" lighting, another device is employed —viz., partial or complete concealment of the light source. In this case, it may result that the principal source is not the brightest object in the field of view. If the concealment is sufficient, there may be a complete absence of points of high intrinsic brilliancy —more so than in the "indirect" system—except for points of specular reflection of the light sources if polished surfaces are present. These latter are of high intrinsic brilliancy in the "direct" systems, and low in the "indirect."

It will be noted by those who have followed this analysis that, while we have lighting systems with large, visible, low-brightness sources, and systems with small, either visible or invisible, high-brightness sources, there are none consisting of large, low-brightness concealed light sources—with the possible exception of some forms of deck lighting, where the light is carried well above a transparent or only partly diffusing glass.

A Large Overhead Light Source.

It follows from the classification just given that the characteristics of "indirect" lighting would be obtained without the process of reflection if a sufficiently large low-brilliancy source was used. This was experimentally accomplished in a very simple manner by the use of a yellowish oiled paper Japanese umbrella, 4 feet in diameter, turned point down, within which are the lights in frosted globes. A certain amount of light falls on the ceiling, so that it might be called a "semi-indirect" system, but by far the greater part of the illumination is due to the visible light source. This is of rather low intrinsic brilliancy, so that it can be looked at without any sensation of strain, and gives ample light all over the 16 ft. by 20 ft. room, with an emission of about 7500 lumens.

Now as to its merits and defects. Because of the size and low intrinsic brilliancy, shadows are soft and specular reflections are too dull to be annoying. Because of the conical shape, a better illumination of the walls and far corners is obtained than would be possible with a ceiling reflection scheme. On the other hand, the direction of the shadows is, for the centre of the room at least, straight down, and therefore different from the most agreeable daylight condition. But the greatest defect lies in the fact that the principal light source is visible; and, low as is the intrinsic brightness, it is the brightest object visible, and is too bright to be continuously in the field of vision. When the occupants of the room sit round the centre table, or sit sideways to the light, the illumination is extremely satisfactory. If, however, when a number of people are conversing, they face each other across the centre, then in time the large bright umbrella becomes an irritant—far less, of course, than the usual bright points, but still noticeable to a sensitive and critical eye.

An experiment was tried with a still larger light source; but it had the same defects. The conclusion was arrived at that by no process of increasing the size of the source, unless it actually occupied the whole upper hemisphere—which is out-of-doors daylight on a sunless day—could the light source be made innocuous. Diffusion is not alone sufficient. Any system by which the light source is the brightest visible thing gives an extreme brightness ratio which is too great to wear well. If, in the room illuminated with the large umbrella, the hand is held over the eyes, or an eye-shade is worn, it leaves little to be desired; there remains merely the question of the direction of the light to be objected to. Indeed, many might prefer the centrally located source. Of course, the higher the light source the less this defect would be; so that the "indirect" practice of making the ceiling the real source chooses the best condition, for it then approximates, in a small room, to a concealed source.

Characteristics of Pleasant Daylight Illumination from Windows.

I have no brief for daylight illumination in general, nor for all kinds of window lighting. Excessively unpleasant illumination may be found by day. On the other hand, daylight at its best has never, in my opinion, had a rival for general excellence. There has been much discussion on this point. Some declare for daylight as necessarily best; others recording themselves as preferring the "mellow," "cosy" artificial light. As a matter of fact, I believe no one has ever had a good copy of daylight to use at night, in place of the ordinary artificial systems. Perhaps it is a case of "sour grapes" with those who say they would not copy daylight if they could. I believe, too, that illuminating engineers have neglected analysis of the good and bad points of daylight. Without this, it is futile to hope to copy the merits or avoid the defects.

An analysis of the various data has led me to the following conditions: The most pleasant conditions are those when the effective light source is of three parts: (1) A large area of bright sky subtending the solid angle of the window, invisible from the greater part of the room, and illuminating the floor and the lower part of the room. (2) A large area of intrinsic brilliancy about one-tenth that of the sky, visible from the room (houses opposite). (3) A large area of intrinsic brilliancy about one-fourth to one-fifth that of the sky, invisible from the greater part of the room, but illuminating its ceiling. Add that these light sources are at the side, and remember that the bright sky is of much lower intrinsic brilliancy than most artificial light sources, and the complete specification of pleasant window daylight of the room becomes something like this: Illumination from large-area concealed light sources at the side—that is to say, just the case we have seen to be absent from prevalent lighting systems. There must be added to this set of conditions the further one that the walls adjacent to the window must be well lighted in order to prevent excessive contrast. This is frequently accomplished by having windows on two sides. In the present case, walls adjacent to windows are perpendicular to these, and are therefore lighted by one set of windows.

Attempts to Approximate Artificially the Chosen Daylight Distribution.

The General Problem.—As an interesting exercise, attention was turned to ways and means for reproducing artificially the best

daylight conditions in the room described. It soon became evident that the problem was not a simple one. It appears, in fact, that there is just one solution, and that is to reproduce entire the broad expanse of the sky, houses, and street. No small light source will copy all the qualities desired. For instance, while it is possible to produce at a given point in the room the general distribution of illumination and brightness given by daylight, the same lighting scheme will not produce the desired effect at another point. The problem is closely akin to that of producing a perspective drawing which would automatically change its perspective as the observer moved, or a photograph in which one could look round the corners by moving one's head from side to side. For instance, a horizontal plate placed above and outside the window would produce the desired sky effect near the window, but would fail farther back in the room. A vertical plate of low intrinsic brilliancy would take the place of the opposite houses as far as the eye of an observer within the room; but the sweep of tenfold brighter light across the floor and the brighter light on the ceiling would be missing. As it was not possible to light up "all out of doors," several approximations were attempted, which are described below. The first of these may be called a lighting fixture; the others, lighting schemes, or, as a non-technical visitor described one of them, "not lights, but light."

(1) *A Side-Wall Fixture to Approximate a Window Effect.*—This fixture might be popularly described as "semi-indirect from the side," though it presents a number of deviations from what would be obtained by merely supporting a semi-indirect bowl out from the wall. In construction, it might be most nearly described by saying it is a table-lamp with the back half and top of the shade removed. In detail, it consists of the light source, which should be of such form, or provided with such a reflector, as to throw its light chiefly below and above the horizontal about as does the prototype window curve, added to which is a large-area translucent screen so calculated as to let the direct light fall upon the wall behind, the ceiling above, and the whole floor of the room, and of such degree of translucency as to closely approximate the brightness of the illuminated wall behind. The device is shown in the accompanying diagram, where it is represented as

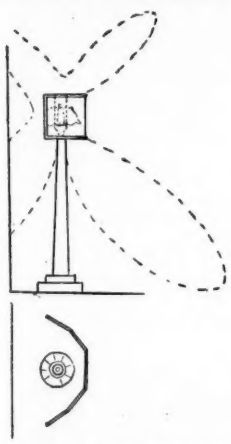


Fig. 1.—A Side-Wall Unit to Approximate Window Conditions.

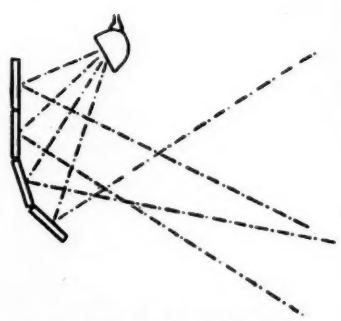


Fig. 2.—Section of Special Reflectors used for Artificial Window.

a floor standard. It will be seen that from no normal position in the room is the bright part of the light source visible, but screen and wall form a large source of low intrinsic brilliancy. This is secured by the peculiar shape of the screen, which is concave to the light with respect to the horizontal plane, half enclosing it, but only large enough vertically to conceal the light from the occupants of the room. The screens so far made up have been covered with flowered silk or cretonne, and lend themselves admirably to the general decorative scheme.

This fixture, when used in a room having light walls (a necessary condition), gives to a large degree the desired window effect. The light is directed from the side, giving the long pleasing shadows; there is a large measure of diffusion, due to the large area of the effective source; and the floor and the furniture have a pleasant "sunlit" appearance. The "thing of beauty" is the light itself, and not, as in many cases, a piece of decorative metal work, designed to be viewed by daylight. The limitations to this device are the necessity for bright walls, which is not serious, and the fact that the direct light in the lower hemisphere cannot be made to fall so far out on the floor as with windows, without carrying the shade too far in front of the light for convenience. It does, however, make an extremely pleasing light source, and has, in several months of use, worn well. It is especially good if two or more are grouped at the window end of the room. It appears that the best height for these shades, if they are to be in the field of vision, is about on the level of the eyes. If a light source must be visible, it seems to be less irritating at this line than at some degrees above. It is perfectly possible to make the shades and the wall behind of such brightness that a person's face may be viewed against them as a background without any undue contrast.

Side-wall brackets have always been popular with those who wish their faces to appear at their best. The defect of most bracket fixtures has been that the light sources have an altogether too great intrinsic brilliancy, and make excessive contrast with the wall behind, especially if the latter is dark wood, as it too often is. This defect is overcome in the arrangement described. There has thus far been no dissenting opinion as to the excellent performance of these side-wall "windows."

(2) *An Alcove Light with Semi-Window Characteristics.*—This scheme was tried after a study of the window considered as a point source, and was carried through in full knowledge of the fact that the characteristics of a large window could not be completely copied without a comparatively large source. This installation is exceedingly interesting. With 7200 lumens, the surface brightnesses through the room measure up, on an average, one-twelfth that found as the average of the two daylight distributions previously given. It was found most desirable, however, to let considerable light go to the ceiling, which gives more light in the room, and approximates more to the "sunlight" case of daylight distribution. This, when the eye is adapted to night conditions, is very nearly ample at every point of the room. Probably twice as much would be more than enough. The room presents a strikingly daylight appearance, except for three things, all due to the same cause. First, the line of demarcation between the light from the "houses opposite" and the "sky" is too sharply marked on the walls; second, the specular reflections on the furniture, books, &c., near the windows, visible on entering the room, are relatively far brighter than they would be by day, as is to be expected; third, the shadows of the furniture are too sharp. These are all due to the point-source character of the light. The appearance is practically the same as can be obtained by covering all the windows except a narrow horizontal slit.

(3) *A Window Reflector.*—The requirement of a large-area concealed light source at the side, having the distribution curve of the window as a light source, may be approximated to by combinations of optical devices, such as prisms and reflecting surfaces. One of these devices forms the last experiment to be described. In accordance with the subject-matter of the paper, it is clear that an "indirect" fixture, if directed towards the wall, would not give the desired window effect, because, while the light source would be large, it would be of uniform brightness as viewed from all directions. In order to secure for this experiment the proper unsymmetrical distribution of brightness, recourse was had to reflecting surfaces intermediate between specular and matt. Measurement of a number of surfaces—such as scratch-brushed aluminum, aluminum paint, mirror glass covered with transparent curtain material, &c.—led to the choice of ribbed mirror glass, sand-blasted on the front. Later it was found better to decrease the brightness of the diffuse component; and this was done by rubbing the sand-blasted surface slightly with oil. Probably a lighter sand-blasting would have given the desired quality. Such mirrors placed with the ribs vertical, and illuminated by a light in front and above, give a large, semi-specularly reflected component, which is nevertheless so much diffused as to appear to come from a large area of mirror—a small diffuse component, the ratio between the normal and reflected brightness being easily made one-tenth by tilting the mirror.

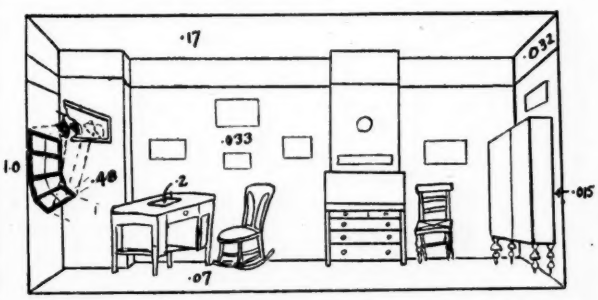


Fig. 3.—Artificial Window Lighting. (Brightness values multiplied by factor 10.)

A pair of frames of these was made, as shown in the accompanying diagram (fig. 2), each frame consisting of four 7 inch by 30 inch elements. These frames were hung in the window, as shown in fig. 3, and were illuminated by a row of small units in the aluminized concentrating reflectors used before. As shown in fig. 2, the specular reflection from the three upper elements illuminates the floors and lower parts of the walls of the room; the bottom elements illuminate the ceiling, taking the place of the brightly lit street pavement before. An observer sitting in the room sees these surfaces as of a uniform low brightness. On dropping his head, he begins to see the top elements brighten, corresponding to the sky appearing over the housetops. On dropping still lower, the other elements brighten, until at the floor the whole window appears a uniform sheet of light. On standing up and approaching the window, the lowest elements become bright in the same manner. This copy of window conditions is, in fact, very close. The reflected light is, because of the ribs and the sand-blasting, excellently diffused. Shadows in the room are long and soft.

The excellence of the copy is shown by the relative brightness measurements. These indicate that the relative brightness of all visible objects is nearly the same as by daylight without the sun

on the floor; the actual brightness being close to one-tenth of that of daylight. In fact, this imitation of daylight distribution in the room is, from the standpoint of relative brightness, direction of light, and diffusion, so perfect as to leave outstanding only the factors of the actual intensity of the illumination and the colour of the light.

Good and Bad Features.—This reflector scheme has many elements of merit. It is in some respects almost uncanny, especially to one not looking towards the imitation windows. The sweep of light over the floor, the illumination of the low portion of the walls, and the brightness ratio between ceiling and floor are most striking, and very different from the usual artificial light conditions. But the general effect is not pleasing. There is a harsh "contrasty" effect. The darker end of the room looks too dark, and the windows too light; the shadows are too inky black. The effect is very much like a foggy day, or as though the houses opposite were brilliantly sun lit. Why is this? In some part, it is due to mental bias, perhaps. The windows do not look just like real windows, and one is strongly conscious of the fact. There is also the fact that the light source is near instead of distant, and that our ocular muscles of accommodation are quite conscious of the real state of affairs. The explanation of the greater part probably lies in two facts—first, the absolute intensity is too low; and, second, the colour of the light is not white. The absolute intensity is about one-tenth of daylight intensity.

My observation leads me to believe that a given physical ratio of brightness becomes subjectively greatly increased when the order of illumination is decreased as much as it is here. If a ratio of brightness of 10 to 1 for different points in the room is satisfactory by daylight, then, with 1 to 10 illumination, this ratio must be decreased to 5 to 1 or 3 to 1. With this low order of illumination, the shadows, such as those on the room side of the face, are so dark as to appear nearly black; the high-light side alone is seen. By the greater light of day, though the relative brightness of the two sides of the face is the same, the dark side is bright enough to be easily seen, and the bright side does not appear too bright.

The general effect in the room is enormously improved by adding the light from two side-wall table-lamps already described, placed in the corners next the alcove. These give somewhat more light; but beyond this, they throw their added light upon the ceiling and side walls without increasing the brightness of the windows. The latter cease to be too bright; the shaded side of the face becomes visible, and a first-rate effect is produced. On turning off the window light alone, the room seems to jump upwards—showing very prettily the importance of the daylight effect of the sweep of light on the lower part of the room.

Summary of Conclusions.

Several conclusions which seem to be justified by these various experiments are as follows: The desirable qualities sometimes found in window lighting by daylight are: (1) Direction from the side; (2) soft shadows and low intensity of specular reflection, due to the large size of the source; (3) the direction of a large part of the light on the lower (usually the darker) parts of the room; (4) the concealment of the principal light source.

It appears possible to make a very close physical copy of the window as a light source, whereby all the characteristics may be duplicated. An attempt to do so shows that to the above qualities must be added (5) large quantity of light as compared with what is usually available from artificial sources. It is suggested that this is less necessary if the artificial windows are placed so as to secure a more uniform distribution of illumination than is necessary by daylight.

These various qualities can be separated to some extent into necessities and luxuries; some are necessary for comfort, others appeal to the æsthetic sense. I believe that, in concealment of the light source so that it is not the brightest object visible, in making it of large area, and in introducing a certain amount of side light from large-area sources of very low intrinsic brilliancy, most of the really necessary, and many of the attractive, characteristics of daylight may be obtained with much lower intensity, and consequently at less cost, than a true copy of daylight. I favour a combination of deck lighting for general floor and working-plane illumination, with side-wall lights of the type described above. If the room is not too large, nothing at present promises to excel the side-wall window brackets (see fig. 1).

Cost of Copying Daylight.

If it were not for the prohibitive cost of an exact copy of good window daylight, it would be a very desirable thing. This paper may be concluded with a calculation of just what this cost is. The room experimented with has an area of 200 square feet; 1600 lumens were used, and ten times these, or 16,000, were required. Supposing absorbing screens were used to make this light of daylight colour, this would call for about ten times the amount of light, or 160,000 lumens, to be generated. Taking the tungsten lamp at 1·5 watts per spherical candle as the light source, one watt per square foot is actually used, 10 watts are called for, 100 watts if subtractive daylight is made, or 20 kilowatts for the room.

Let us finish, however, with a little speculation and prophecy. If we could produce white light, with no accompanying invisible radiation or other losses, by some merger of fire-flies, there should result an efficiency of 330 lumens per watt, or about 40 times that of the tungsten lamp. Since 16,000 lumens are necessary to produce daylight intensity and distribution in this [the meeting] room, there would be required for this ideal white light 16,000 ÷ 300 lumens, or about 50 watts. This, it is interesting to note, is just about what the builder of the house has provided for in the low-hung, glaring, and utterly horrible central fixture. Artificial daylight may not always be a luxury.

OIL GAS AND ITS MANUFACTURE.

The Pacific Coast Gas Association have, it may be remembered, a fund for maintaining the "Degree of Gas Engineer," which has for some time formed a section of the curriculum at the University of California. Mr. John A. Britton, the General Manager of the Pacific Gas and Electric Company, delivered the first of a series of lectures to the students during last session—dealing historically with the development of artificial gas. Subsequently, Mr. E. C. Jones, the Chief Engineer of the Gas Department of the Pacific Gas and Electric Company, followed with a series of lectures, one of which we reproduce to-day, treating of the "Manufacture of Oil Gas."

Of all the substances from which gas is made, oil is best suited in every way. It naturally contains every element needed in illuminating gas, and combinations of elements so arranged that it only needs the skilful touch of the chemist to rearrange them into any desired gas without waste. Compared with solid fuel, oil may be more conveniently and cheaply handled, and may be stored in smaller space. The steam or electrically driven pump takes the place of the shovel, wielded by manual labour, as well as every form of mechanically operated coal-handling device. The metal oil-tank displaces the wooden coal-shed; and each cubic foot of oil contains 67 per cent. more energy than a cubic foot of coal as stored. A cubic foot of California petroleum contains 1,151,172 B.Th.U., while a cubic foot of bituminous coal contains 689,000 B.Th.U.

The ready adaptability of oil to gas making caused the pioneers of the industry to divide their attention between oil and coal; and many of the early efforts to design apparatus show that more ingenuity was used in devising means to distil gas from oil than from coal.

Early Attempts at Making Oil Gas.

An example of this is the description of Taylor's patent gas apparatus (for making gas from oil) in the "Franklin Journal," Philadelphia, in 1827. This was nine years (1836) before gas was supplied to the inhabitants of Philadelphia. The Taylor method of making oil gas consisted of two vertical iron retorts set in a single furnace. These retorts were furnished with a mouthpiece and luted lid at the top end. A metal pipe passed through each lid to near the bottom of the retort, and the lower end of each pipe was perforated with holes. These pipes were connected together at the top so that the retorts were used in tandem. The retorts were filled with broken bricks. This is the first recorded use of chequer brick.

To make gas, the retorts were externally heated until the broken bricks were red hot. Oil was then admitted to the space above the brick in one of the retorts, and passing downwards through the broken brick entered the central pipe through the perforations, and passing upwards and over into the pipe in the second retort escaped through the perforations in the bottom of the second pipe, and finally passed upwards through the broken brick in this retort and through an outlet-pipe in the mouthpiece of the second retort. In this way the oil was gasified. The inventor probably never knew how many essentials of modern oil-gas making were included in his invention; and could a plentiful supply of petroleum have been substituted for the sperm oil of those days, it would have changed the history of the gas business.

The City of Edinburgh was lighted by oil gas in 1824, when the Edinburgh Oil Gas Company was established, with Sir Walter Scott as Chairman. The failure of the undertaking plunged this noble and brilliant man into debt from which he never recovered, and the whole of the money received from many of his works was turned over to his creditors. Evidently the time was not ripe for oil gas.

It would require a volume to record the oil-gas processes invented and promoted between the failure of the Edinburgh Company and the water-gas invention of Professor Lowe. These depended on the external heating of retorts of various shapes for vaporizing or gasifying oil. Horizontal retorts containing nests

of pipes were used for making oil gas for enriching coal gas; and a combination of vertical and horizontal retorts known as the "boot-leg process" (from its similarity in shape to a boot) was used to manufacture water gas containing less than 10 per cent. of carbonic oxide. These "boot-leg" retorts were filled with fragments of limestone, with the expectation that the resulting calcium oxide would dissociate steam and absorb carbonic acid gas. The gas made in this way was a primitive form of oil gas, varying in its composition with the temperature of the retort; and little, if any, steam was decomposed in passing through the lime.

During the progress of experiments with this process, it was demonstrated that the oxygen of steam will not unite with carbon while it is combined with hydrogen in the form of hydrocarbons. Carbon must be in a free state, and heated to incandescence, before it will dissociate steam and form carbonic acid gas or carbonic oxide.

All these processes relied upon the treatment of oil under comparatively low temperatures for its destructive distillation, and the conduction of heat through the refractory material of retorts was both wasteful and ineffectual. The use of oil in the internally heated apparatus of Lowe for the enriching of water gas did not contemplate the breaking-down of oil into diluent gases and the cracking of hydrocarbons into hydrogen and lampblack. The temperature now maintained in the superheaters of carburetted water-gas sets seldom exceeds 1400° Fahr., which is about 1200° Fahr. less than the temperature employed in breaking-down oil in the early oil-gas apparatus.

The Modern Method.

The first step in the evolution of the present method of making oil gas was the patent issued to L. P. Lowe, then of Lynn (Mass.), on June 18, 1889, for "Apparatus for the manufacture of hydrocarbon gas." This apparatus consisted of "chambers lined with refractory material, each having an open-work filling of refractory material"—in other words, generators filled with chequer brick and internally heated by combustion of oil and air, thus storing heat in the brick, to be subsequently used for breaking-down the oil during the gas-making period.

At the time of the invention, it is safe to say that there was no place in the world, in proximity to a market for the gas, where the price of oil was low enough to permit of the economical commercial success of the process. In that year, the entire production of oil in California was only 303,220 barrels. The invention was in anticipation of its usefulness by many years; for it was not until 1899 that the first crude oil water-gas works was built in California, and the first installation for lighting a large city was started in Oakland in 1902. The apparatus employed consisted of two cylindrical shells lined with fire-brick and filled with chequer brick. This was heated by oil injected under pressure with steam and a blast of air for combustion.

In radically departing from all methods previously used for making gas from oil, it was thought to be necessary to subject the oil to extremely high heats; but this destroyed a large portion of the oil, and reduced the candle power of the gas. A large amount of lampblack was also produced; as much as 30 lbs. per 1000 cubic feet of gas being no uncommon yield. Thus the lampblack bye-product and the gas made from the oil were nearly of equal weight. It was supposed that lampblack was a necessary result of making oil gas, and that the lampblack might be used within the generator for dissociating steam and producing blue water gas. It was soon discovered that lampblack was deposited by the destruction of hydrocarbon gas, and that the amount of lampblack produced and of free hydrogen in the gas were closely connected. Samples of early oil gas contained as much as 62 per cent. of hydrogen, and the carbonic oxide content was 3 per cent. This is evidence that little, if any, of the steam admitted to the generator was decomposed by lampblack.

In the development of a standard oil-gas process it became necessary to discard the use of arches over combustion chambers, because they would not stand the intense blow-pipe effect of the oil-fire. The area of the chequer brick was increased, and means were provided for controlling the heat in different parts of the generators. These improvements reduced the amount of lampblack made and the percentage of free hydrogen in the gas. The quantity of oil used to make the gas was reduced from over 12 gallons to less than 8 gallons per 1000 cubic feet.

Present-Day Apparatus.

The apparatus which now seems to be giving the most satisfactory results in making oil gas consists of two cylindrical shells connected at the bottom by a throat-piece—forming a U, one leg being longer than the other. The shorter of the two shells is known as the "primary" and the longer as the "secondary" generator. These shells are lined with fire-brick, and are filled with chequer brick. The outlet for gas is placed about midway the height of the secondary shell, and above this outlet there are a series of arches reaching across the shell to support more chequer brick. Air is admitted under pressure for combustion of the oil at the centre of the top of the primary shell, and also near the bottom at the side of the secondary shell. This last is called the "secondary blast." The outlet for the escape of waste products of combustion is through the top of the secondary shell, and is known as the stack-valve.

The oil used for heating the chequer brick is sprayed through a number of burners on the side and near the top of the primary shell. The oil is pumped to these burners through a ring of pipe extending around the shell, and parallel to this is a ring of steam piping. The oil for making gas is conducted through separate rings of pipe to separate burners placed near the heating burners on the side near the top of the primary, and there is also a ring of pipe and a series of burners for spraying oil for making gas at the side near the top of the secondary shell.

To make the gas for the first time, it is necessary to heat the chequer brick in both shells to a temperature high enough to ignite oil. This is done by building a wood fire in the primary. Air is then admitted to the top of the primary by opening the blast-valve, and oil is then forced through the heating burners under pressure, and assisted by steam also under pressure. The oil burns above the chequer brick in the primary, and the heat is transmitted downward and upward through the brick in the secondary; the products of combustion passing into the atmosphere through the stack-valve. The process is intermittent, and includes a blowing period and gas-making period the same as for water gas. No solid fuel is used, as oil is burnt completely to furnish heat for the chequer brick. Steam is used for injecting oil, for the purpose of protecting the oil vapour against destruction by overheating, and to add its quota of blue water gas to the oil gas. By this process, gas is made entirely from oil and steam, and the elements in the oil and steam provide every element and combination of elements in the gas.

The largest oil-gas units as used in the cities around the bay of San Francisco are known as 16-feet sets. [See illustration.] The primary and secondary shells are each 16 feet diameter, and the set has a rated capacity of 150,000 cubic feet of gas per hour. If the total amount of oil used to make 1000 cubic feet of gas is 8 gallons, it is divided between heating and making in about the proportion of 1·3 gallons for heating and 6·7 gallons for making.

The sequence of operations during a blow and run, after the set is in condition to make gas, is as follows:

Heating.—(1) Air is blasted into the primary for three minutes without any oil. (2) Air is blasted and oil injected into the top of the primary for seven minutes.

Making.—(1) Oil is injected into the primary and top of the secondary for seven minutes. (2) Steam is injected without oil for three minutes. This is known as the purge.

For the purpose of keeping the chequer brick free from carbon accumulations, after every eleven runs there is a long blow. Air is blasted into the generator without oil for ten minutes, after which oil is admitted with the air, and the regular heating period of seven minutes begins.

The oil used should be preheated to as high a temperature as is consistent with the use of steam for heating. It is most economical and satisfactory to use a large oil heater containing enough oil for at least two runs, and heated by the exhaust steam from the blower engines. The burner used for spraying oil should be so adjusted that there is no change in the velocity of the stream of oil and steam after it is atomized; and the oil should be projected into the generator as oil fog. It is then in the best condition to be quickly heated and cracked by the radiant heat in the chamber at the top of the primary, and converted into fixed oil gas by contact with the hot surfaces of the chequer brick.

The temperature of the chamber at the top of the primary at the beginning of the run is from 1800° to 2100° Fahr., and this falls to about 1200° Fahr. during the gas-making period. It is then restored during the blowing period. The range of temperatures in the chequer brick of the secondary generator is from 1200° to 1800° Fahr. during the gas-making period.

By exercising care in atomizing the oil and regulating the heat of the chequer brick, the amount of lampblack has been reduced from 30 lbs. to 10 lbs. of dry lampblack per 1000 cubic feet of gas; and the hydrogen content of the gas has been reduced from 62 to about 45 per cent., with an almost corresponding increase in marsh gas. This has resulted in a substantial reduction in the amount of oil used to make the gas, and the gas is of greater heating value.

Some Recent Improvements.

There have been quite recently some revolutionary improvements in oil-gas making. It was discovered that if oil is caused to be dissociated in a hydrogen atmosphere instead of in an atmosphere of its own vapour, there is practically no breaking-down of the hydrocarbons into free carbon (or lampblack) and free hydrogen. This means that oil gas can be made without producing lampblack; and practical results with an apparatus provided with a gas-chamber show a production of about 5 lbs. of lampblack per 1000 cubic feet.

In this new apparatus, the oil for heating is not burned directly above the chequer brick in the primary, but is consumed in a separate heating chamber at the top of the primary. This chamber also contains a few courses of chequer brick. It is possible to heat the chequer brick in the primary and secondary very evenly, and with no overhead incandescent spots.

After a generator is heated by this method, steam is turned into the upper combustion chamber, and is superheated in passing through hot chequer brick. Ordinary illuminating oil gas taken from the holder is forced under pressure into the top of the primary, and the oil for gas making is sprayed into this gas atmosphere. This catalytic gas is simply borrowed for the purpose, and due credit is given for it. Its chemical constituents are rearranged, and its volume is increased; but its heating value is not impaired. By this method of protective heating of a generator, it is possible to maintain the temperature of the chequer

brick with only a variation of 300° Fahr. between the extremes of blow and run.

The accompanying table gives the chemical composition of the new "Metropolitan" oil gas.

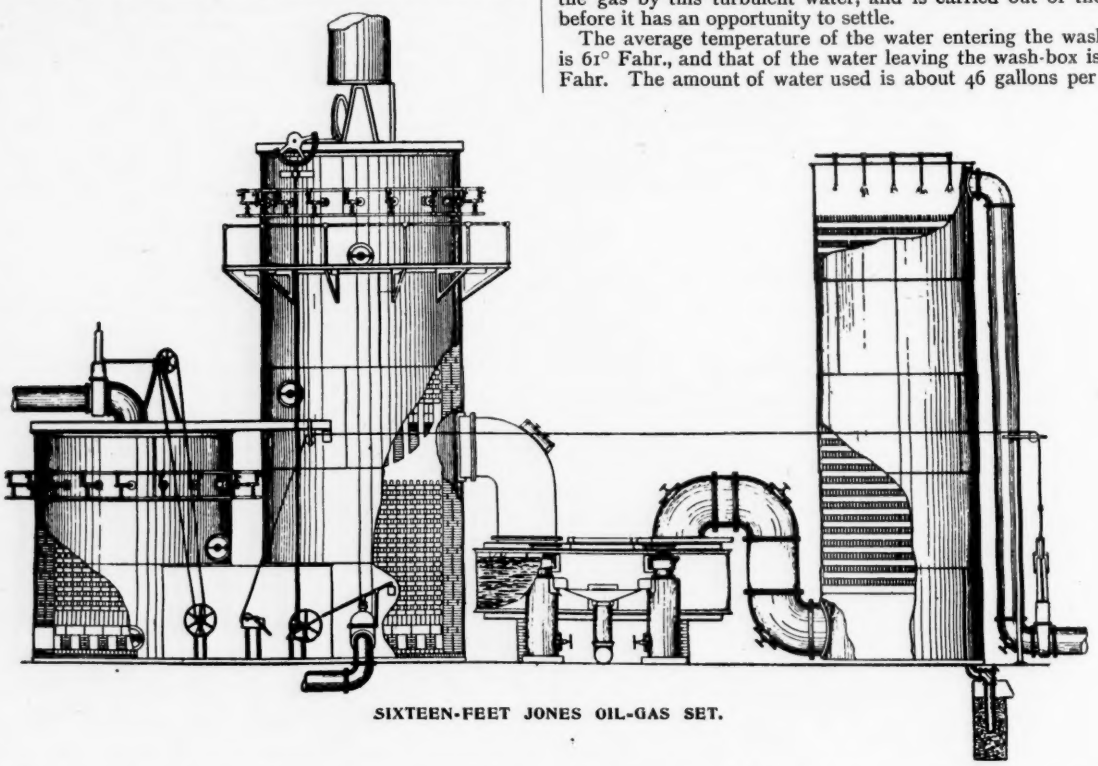
	Per Cent.
Illuminants	6·0
Marsh gas	40·4
Hydrogen	41·4
Carbonic oxide	5·3
Carbonic acid	2·0
Oxygen	0·1
Nitrogen	4·8
	100·0

Illuminating power	19·6 candles
Calorific power	714·0 B.Th.U.
Specific gravity	·440

After the oil gas leaves the generator, it passes into the wash-box, which is a hydraulic seal to prevent the return of the gas to the generator. The wash-box also serves to separate the lampblack from the gas by a thorough system of washing; and the lampblack held in suspension in water overflows from the wash-box to the lampblack separators. The wash-box now generally used is an oval steel tank with flat top and bottom, provided with an inlet dip-pipe at one end of the top, and an outlet-pipe for gas at the other end. There are no partitions or baffle-plates used, and the space within the box is perfectly clear. Two large overflows on the side of the wash-box carry away the lampblack and water.

A self-cleaning principle applied to this wash-box consists in constant agitation of the water in the box. This is done by dividing the main water supply into a number of small streams conveyed by pipes to within a few inches of the bottom of the box. The water is thus forced downwards to the bottom of the box, and rises to the overflows. The lampblack is washed out of the gas by this turbulent water, and is carried out of the box before it has an opportunity to settle.

The average temperature of the water entering the wash-box is 61° Fahr., and that of the water leaving the wash-box is 129° Fahr. The amount of water used is about 46 gallons per 1000 cubic feet of gas. When it is available, salt water is used in the wash-box, and also in the scrubbers, without the slightest injury to the gas; and though the temperature of the water is considerably raised in both the wash-box and scrubbers, there has never been trouble from salt incrustation. The average temperature of the gas at the outlet of the wash-box is 142° Fahr. The water and lampblack flow from the wash-box through open drains to the lampblack separator.



SIXTEEN-FEET JONES OIL-GAS SET.

It is necessary to thoroughly scrub oil gas; and more water is used for scrubbing it than either coal or water gas, on account of the finely-divided particles of lampblack held in suspension in the gas, and which must be completely removed before the gas enters the purifiers. A small quantity of oil tar is also removed from the gas by scrubbing. The scrubber best suited to the treatment of oil gas is the cylindrical steel tower filled with wooden trays. The gas inlet is at the bottom, and water is sprayed on the top of the trays so that the gas and water flow in opposite directions. It is customary to use three of these scrubbers for each 16-feet set, and the amount of water employed in each scrubber is approximately 15 gallons per 1000 cubic feet of gas, or 45 gallons per 1000 cubic feet for the complete scrubbing of the gas.

In purifying oil gas, the method is the same as that used for coal or water gas. Oxide of iron is the cheapest and most satisfactory material; and if the amount of sulphur contained in the oil is less than 1 per cent., there is no difficulty in removing all the sulphuretted hydrogen and reducing the sulphur compounds contained in the crude gas to 8 grains per 100 cubic feet.

When oil containing any excessive amounts of sulphur is used for making oil gas, it has sometimes been the practice to re-heat the gas by passing it through an auxiliary generator containing heated chequer brick. This re-heating process converts the sulphur compounds into sulphuretted hydrogen, which is removed in the usual way by iron oxide in the purifiers.

There is never any ammonia present in oil gas as it leaves the generator, though ammonia is formed from the oil in the initial stages of the process, and is subsequently destroyed by contact with the highly-heated chequer brick, and appears in the gas as hydrogen and nitrogen. The only bye-products are lampblack and a small quantity of tar. The lampblack is recovered by separation from water in large wooden separators arranged in two sections, by partitions running lengthwise through them, to permit the alternate cleaning and use of the sections. These separators are provided with transverse partitions and skimmers, and the water containing lampblack passes under the skimmer and over the partitions. The specific gravity of lampblack and water is so nearly alike that the separation is necessarily slow; but the particles of lampblack gradually settle through the water to the bottom of the tank. It has been demonstrated that to separate the lampblack thoroughly from the water, a large area of separator is required, and a slow speed of flow of water through it.

The amount of oil tar made is so inconsiderable that it is customary to mix it with the lampblack for use as fuel, or as a binder to assist in briquetting the lampblack.

In some of the larger plants, there have recently been installed mechanically operated de-watering and drum filters for separating lampblack. This is an application to a new use of apparatus used in connection with the cyanide process for treating gold ores. The de-watering filter contains a number of leaves covered with cloth, and connected by a rotary valve to a vacuum pump and compressor, which alternately places suction and pressure on each leaf in rotation. This machine treats water from the wash-box containing 3 per cent. of lampblack, removing the water and thickening the mixture until it contains 10 per cent. of lampblack. The drum filter, which also utilizes the vacuum and pressure principle, then receives this mixture, and further removes the water until the lampblack scraped from the outside of the revolving drum and falling on to a belt conveyor contains 50 per cent. of water and 50 per cent. of lampblack. Lampblack in this condition is used as boiler fuel, or, after slow draining in a pile, is employed in water-gas generators as a substitute for anthracite coal. The composition of the drained lampblack ready for use as water-gas fuel is as follows:

	Per Cent.
Volatile matter, including moisture	34·15
Fixed carbon	65·80
Ash	0·05
	100·00

Lampblack used in this way in a water-gas generator reduces the capacity of the generator, when compared with anthracite

coal, by about half. To overcome this drawback, rotary driers are used for further removing the moisture; and the heated dry lampblack is then made into briquettes the size and shape of a fire-brick. This material compares favourably with other generator fuels, and the capacity of the apparatus is nearly normal. Lampblack, after it leaves the drier, is also made into smaller briquettes for domestic use, and as a fuel it is deservedly popular on account of its extremely low ash content. When ignited, it glows until it is all consumed.

Oil gas is so nearly like coal gas in its chemical composition that it would be impossible to detect one from the other when analyzing samples in the laboratory. To demonstrate this, three analyses are given below in parallel. No. 1 is an analysis of Manchester coal gas; No. 2, one of oil gas made at the Martin station on Jan. 17, 1913; No. 3, one of oil gas made at Fresno (Cal.) on Feb. 7, 1913.

	No. 1.	No. 2.	No. 3.
Illuminants	6·46	6·6	6·2
Marsh gas	34·90	35·0	37·0
Hydrogen	45·58	42·9	45·6
Carbonic oxide	6·64	7·2	5·8
Carbonic acid	3·67	2·0	2·2
Oxygen	0·00	0·2	0·4
Nitrogen	2·75	6·1	2·8
	100·00	100·0	100·0
Candle power	16·00	19·9	20·0
Cal. power, B.Th.U.	683·00	680·0	685·0
Specific gravity	·435	·450	·414

The candle power of the oil gas is higher than that of the coal gas, because of the difference in the quality of the illuminants which yield illuminating power. The quantity of the illuminants is nearly the same, and, in fact, a little less in the Fresno oil gas.

The manufacture of oil gas is a live subject of interest to everybody who lives in this land of abundant oil. There is much to be learnt about oil gas; and the study of the hydrocarbons, and their behaviour at different temperatures, will doubly reward the investigator.

Substitution of Benzol for Petrol in Motor-Cars.—On this subject an explanatory booklet, entitled "Benzol and How to Use It," is being published by the Petrol Substitutes Joint Committee, which is composed of three executive members of the Committees of the Royal Automobile Club, the Society of Motor Manufacturers and Traders, and the Automobile Association and Motor Union. A copy of the booklet will be sent to any motorist on application to Mr. Stenson Cooke, Secretary of the Committee, Fanum House, Whitcomb Street, London, W.C.

Water-Works Directory and Statistics.—We have received from Messrs. Hazell, Watson, and Viney, Limited, of Long Acre, W.C., the "Water-Works Directory and Statistics for 1912-13." This is the thirtieth issue, and the work is well known to many of our readers as the companion volume to the one dealing with gas-works, issued by the same publishers. The contents have been corrected up to June last; and every effort was made by the Editor to give the fullest, latest, and most reliable information obtainable. In addition to the statistics of English and Foreign water undertakings, there are given a general index of officials of water-works, and also a list of Associations of Engineers and Managers of Water-Works. The book costs 10s. 6d. net.

Cost of Mixtures of Coke-Oven and Carburetted Water Gas.—In view of the extended supply of coke-oven gas for general purposes in Belgium, attention may be called to a series of three tables compiled by M. Vander Willigen, the Continental representative of Messrs. Humphreys and Glasgow, Limited, and given in the "Bulletin" of the Belgian Gas Association. He takes the case of coke-oven gas supplied from an outside source, and enriched by carburetted water gas made on the works into which it is delivered, and he gives the cost of such a mixture, having a gross calorific value of 5000, at 15° C. and 760 mm. The cost depends upon four factors—viz., the calorific power and the price of the coke-oven gas and of the carburetted water gas; and the author's object is to show the relative influence of each of them. The tables, with the explanatory note accompanying them, form a very useful contribution to the Association's "Transactions."

A Survey of the Lighting Field.—The Illuminating Engineering Society of New York are undertaking, through the President (Mr. Preston S. Millar), the preparation of an exhaustive survey of present-day lighting conditions; the object being to record as nearly as possible the lighting practice in a number of different fields. It is expected that the survey will afford concrete information on the present situation, and provide a basis of comparison for future estimates of progress. It will probably be of most value at the present time in enabling individuals and companies to compare their practices with general practice and conditions; and it should disclose what is judged the most advanced practice in each field. For the purpose of the survey, the whole area of the United States has been divided into 89 different sections, each containing approximately a million inhabitants. Into each district various lists of questions regarding illuminating practice are being sent to representative companies and individuals in the professions and industries specially concerned. The information obtained will form the basis of a paper to be presented at the Pittsburg meeting of the Society during the week beginning on the 22nd inst.

ANIMAL GROWTHS IN WATER-PIPES.

By Samuel C. Chapman, M.Inst.C.E., of Torquay.

[Abstract of a Paper read before the Institution of Water Engineers.]

Much has been written in recent years concerning the incrustation of water-pipes, and the retardation of flow due to the action of Cladothrix and kindred organisms; but comparatively little has been said, in English circles at least, of those animal growths which sometimes appear, and whose presence has been the source of considerable anxiety to those responsible for the administration of the undertaking in whose mains the creatures have ensconced themselves. That so little has been written on the subject, is probably due to the fact that in a majority of works the whole of the water sent to the consumer is filtered, and the state of the pipes conveying water to the filters is not a matter of great concern, provided their efficiency remains unimpaired. Further, the difficulty rarely (if ever) arises in connection with supplies drawn from underground sources; so that the question of animal growths is limited practically to those undertakings whose supplies are drawn from rivers or from upland surface sources.

In the early days, before filtration was so universal or had reached its present state of efficiency, it was not an uncommon thing to hear of almost every description of fauna inhabiting the distributing mains, especially in cases where the supply was drawn direct from rivers and streams. Among the older records, mention is often made of eels or other kinds of fish, and mussels—to say nothing of sponges and pipe moss, or polyzoa.

The history of the cholera outbreak at Hamburg is so well known that more than a passing reference to it is unnecessary. The close and exhaustive investigations which followed that terrible visitation revealed the fact that the Elbe water, which was unfiltered, carried with it into the city's distributing mains sufficient nourishment to sustain the most prolific species of animal life. Besides sponges and polyzoa, which furred-up the pipes to a considerable extent, there were found snails and water-lice in hundreds at every examination; while mussels, eels, sticklebacks, and even flounders made their homes in the water-mains. Dr. Kraepelin tells us that he found over fifty genera of animals in the pipes. Ever since the introduction of filters, however, the numerous inhabitants of the pipes have died off; and at the present time there are no animal growths of any description in the Hamburg distributing mains.

It is hardly necessary to remark that no one at the present time ever expects to hear of such highly developed animals as fish or eels in a town's distributing mains. Yet in many works where filtration has not been adopted, the lower growths are to be found in the pipes, and in some instances to such an extent as to cause much trouble and anxiety to those responsible for the administration of the supply. In the United States especially has this been the case; and there are, no doubt, many instances in this country where animal growths exist in pipes and conduits, which, by reason of their moss-like formation, have been wrongly ascribed to the vegetable kingdom.

Where water is drawn direct from rivers or impounding reservoirs without filtration, small free-swimming creatures are often drawn into the pipes, and so find their way into service reservoirs, and thence into the distributing mains. At certain seasons of the year their numbers may be very considerable; and the changes of temperature in the water in impounding reservoirs causes them to transfer their feeding grounds to such levels as may be within the area of influence of the draw-off pipes, and vast numbers may be carried into the mains thereby. The quantity of such life in a reservoir depends largely, or it may be said entirely, on the available food supply therein; and in new works, where food is more abundant, the number of these animals would be proportionately large.

The author had under his observation a short time ago a remarkable instance of the presence of these organisms in their myriads. The supply was drawn from a storage reservoir which had been in use for about five years; and before entering the trunk mains the water was passed through a battery of mechanical filters. These, under ordinary conditions, required cleansing about every seven days. It was found necessary to wash them out more and more frequently; and at last the interval between successive washings was reduced to four days.

The manhole of one of the filters having been removed, it was found that the rapid clogging-up was due to the presence of daphnia, which covered the surface of the filter to a depth of half-an-inch or more. To ascertain whether the whole reservoir was alive with these creatures, samples of water were taken at various depths (the reservoir was 50 feet deep); and it was found that they were assembled in the greatest numbers at a depth of between 15 and 20 feet from the surface. The water being then drawn off at another level, the filters were at once relieved of the extra work they had been called upon to bear.

The open surfaces of water, whether in service reservoirs, clear-water tanks, or in channels, lend themselves to the introduction into water-mains of free-swimming animals. As is well-known, many winged insects lay their eggs at the margins of open-water surfaces; and when these hatch-out, the larvæ spend one part of their existence as free-swimming animals before reaching a further stage in their development. The larvæ sometimes find their way into the pipes, and some may even reach the consumers; and

though their presence may be easily accounted for, and it may be proved conclusively that the water has been properly filtered, the man-in-the-street will still be of the opinion that there is something amiss with the supply.

The larvæ of the dipterous insect are frequently found in mains carrying water from surface sources; and the author has observed them frequently among specimens of sponges and polyzoa taken from mains and aqueducts in various parts of the country. Water-snails and water-lice, too, are to be found associated in the same manner with polyzoa and other organisms, no doubt because these growths afford both food and shelter for them. There is little doubt that when polyzoa in various forms become lodged in pipes, they at once attract large numbers of creatures, which either prey upon them or shelter among their tangled masses.

Some years ago the author witnessed a rise of flies from the surface of a reservoir at Plymouth (the water was unfiltered). The caretaker reported that the screens at the outlet, which had an area of about 150 square feet, were blocked, and the reservoir was overflowing—a most unusual circumstance. Close examination revealed the fact that winged insects were rising in myriads to the surface, and while so doing many were drawn against the screens and killed. The dead bodies of these flies were jammed into a solid mass of considerable thickness against the surface of the screens. Above the surface of the reservoir were swallows innumerable, which found an easy living, on this occasion at least. Without the screens, considerable annoyance would have been occasioned to many consumers by the influx of these insects into the town's water supply.

Fortunately, many of these free-swimming organisms do not, as a rule, make the pipes their permanent abode; and they may be regarded simply as occasional and unwilling passengers on their journey to ends unknown. And, furthermore, they often become broken up to such an extent that little remains which can be detected without the aid of the microscope. There are, however, organisms which find the inside of pipes a very congenial place in which to take up their residence; and among these, pipe-moss or polyzoa and sponges are worthy of special notice. The first of these has been found in a variety of forms in many water undertakings in this country and on the Continent; while they are found in nearly every unfiltered surface supply in the New England States. Sponges are also common in surface waters, and are found under almost the same conditions as the polyzoa.

The question naturally arises as to whether, and in what respect, these growths are injurious to a water supply; and it may be said at once that they are not pathogenic. One of the chief objections to these growths lies in the fact that they produce mechanical difficulties which are exceedingly detrimental to any water undertaking. Thus at Hamburg, sponges, polyzoa, and other organisms were found covering the interior of the pipes to a considerable thickness, and to such an extent that the capacity of the pipes was seriously interfered with. At Antwerp, Dr. Kemna some years ago discovered a growth of polyzoa in a 24-inch main conveying unfiltered water, which reduced the clear diameter of the pipes to 16 inches.

In many cases, the surface of the growths resembles thick, rough matting; while in others they are surrounded by a collection of mud and slime. Sponges are most irregular in their growth, sometimes forming a thick, smooth surface; while other forms may protrude long finger-like projections into the water. The author examined a 12-inch pipe some time ago which was coated with sponge to a thickness of nearly half-an-inch. This was found to have a very rough surface. The growth had covered up the rust nodules that were on the surface, and had used these irregularities evidently to their own advantage, by sending therefrom projections into the water area for the better acquirement of food. The result was a surface of the worst possible type for obtaining an efficient flow of water. There is little doubt that these growths not only reduce the sectional area of a pipe to a considerable extent, but the rough surface which they form adds another factor which again materially reduces the flow. It is held by some that these organisms (polyzoa especially) tend towards the production of rust nodules, that they become firmly attached to the pipe coating, and when they die down or become torn away from their positions, the coating is damaged, and in some places entirely detached from the metal, leaving the surface exposed.

However, though the effects of the organisms so far mentioned have been chiefly prejudicial to the water authority, the consumer has just as much cause to resent their presence. The natural death of the polyzoa, as well as those conditions which sometimes bring about their wholesale destruction, liberates into the mains large masses of tangled, mosslike growths, which become broken up and carried into every part of the system, following generally the direction of greatest demand. It thus follows that the most important supplies are those which first feel the inconvenience of their presence. The house services are first blocked at the ball-valves, and metered supplies follow. Unfortunately, the trouble is not of a single day, but may continue for a long period.

The main question for water engineers is: What means can be adopted to remove these creatures from the pipes? Many attempts have been made, and with partial success. The only safe and satisfactory method is starvation—that is to say, to filter out the plankton which forms their food; and they must then die off, and the trouble be ended once and for all. It may be asked whether it is possible to adequately treat water in bulk in storage reservoirs so that these growths may be eradicated at the sources of supply; and the author therefore quotes the following from a communication he received from Dr. Kraepelin in reference to the Hamburg mains: "No means of prevention has been tried at Hamburg. It would, indeed, have been quite impossible without poisoning all the inhabitants of Hamburg at the same time. . . . The destruction of this growth can only be brought about by the withdrawal of nourishment—that is, by careful filtration of the water." Dr. Kemna, at Antwerp, had only a short length of main to deal with; and it was possible to isolate this and to turn live steam into it, with the result that the creatures were cooked. Water was afterwards turned in, and the dead growth flushed out. In several instances flushing under heavy pressure has been resorted to, with only partial success. The available evidence all tends to show that filtration is the only complete remedy for the trouble caused by these growths; and, referring to the polyzoa, &c., in the New England water-works, Professor Whipple definitely states that, "where water is filtered, or where ground waters are used, they do not occur."

Unfortunately, however, surface water supplies are at any time liable to a sudden development of these animal growths, as is shown by the following facts: In Torquay, the supply has been drawn from the same source since 1859; and up till September, 1910, no single trace of polyzoa had ever been seen. Suddenly, within a period of twelve months, the growth spread to every part of the area of supply. There are three storage reservoirs from which the supply is drawn. The highest has an elevation of 820 feet above O.D., and holds 194 million gallons. The second holds 103 million gallons, and has a top-water level of 783·6 feet above O.D. The third reservoir holds 171 million gallons, with the overflow at 769 feet above O.D. The last one has only been in use five years; while the others have been in operation for a long time. Curiously enough, the growth was greatest in the area supplied from the highest reservoir; and never before the date given was any trace of it seen. The only suggestion which can be made as to their introduction is that they were carried either by wild fowl or with fish obtained for stocking the reservoirs.

DISCUSSION.

The PRESIDENT (Mr. C. Clemesha Smith, of Wakefield) said it was fortunate that in this country they did not all suffer from these animal growths in water-mains. But they did not know whose turn it might be next; and therefore he hoped the discussion would be of great value. They had with them Dr. Kaye, the Medical Officer of Health for the West Riding of York; and he was sure they would all like to hear something from him upon this matter.

Dr. KAYE said he had listened with interest to the paper. Of course, the question had been dealt with from a mechanical point of view; but it was a great consolation to hear that these organisms were not pathogenic. He had had nothing to do with these questions; but in two cases—one in a particularly large reservoir which was supplied from upland sources—the water constantly developed a fishy odour. The reservoir had two inlets; and one was inclined to be a little suspicious of some slight introduction of sewage. There was only one outlet, which was about 12 feet deep generally. They found there were something like ten or twelve dozen trout in the reservoir; and the question arose as to whether they gave rise to the odour. Upon a chemical examination being made, the water was found to be fairly pure. A bacteriological examination showed that there were practically no organisms resembling anything they had read about which could be demonstrated as a cause of this peculiar smell. One or two organisms were found; but they were not in sufficient quantity to explain the fishy smell. The seasonal prevalence was important, because this odour only occurred in the autumn. This rather discountenanced the theory that it was due to the fish. He would like to hear whether Mr. Chapman had had any experience of a similar case. What they did was to stop the inlet which they rather suspected. From the evidence of the vegetation around, they had some slight suspicion of this. The next thing they did was to have the pond dragged with a huge net, when they found the fish he had mentioned, and killed them off so as only to leave about three dozen. This was only last year; and they had not had sufficient experience to see whether the evil had been cured. He would like to know whether the smell was due to the fish or to some organism.

Mr. JOHNSON (a member of the laboratory staff of the West Riding Rivers Board) said that the cause of the growth of organisms in water was undoubtedly due to the food supply therein; and these organisms tended to improve the water by consuming the *débris*—thus making the water purer. As to the other side of the question, if they had a pure water they would not have any organisms. This was the basis Continental observers had used in the classifying plans, particularly in regard to sewage problems in streams. It was perfectly obvious that the larger organisms needed more carefully considered attention than the smaller, as would be seen when one considered what happened in a sewage-polluted stream. The higher forms died out, and then the lower; and eventually they got down to the bacterial. It was the extreme difficulty in removing the necessary food material that made bacteriological tests of water supplies so important. When they considered the water supply, and found it contained very low bacteria, it necessarily meant that the food in the water had been reduced to a considerable extent. In the Wakefield water supply, they had essentially water from an area which contained, chemically, very little pollution. The only objection was the peat. Peat offered two objectionable points. Firstly, it was acid, and brought about

plumbo-solvency; and along with this it had an unpleasant and unsightly appearance. By suitable treatment, it was possible to remedy the plumbo-solvency and produce an abundantly clear water. The Wakefield water supply was, in his opinion, second to none in the kingdom. With a water containing little or no pollution, even the bacterial contents might be very much reduced. But when one had reduced the amount of pollution, and secured a very clear or almost clear water supply, there was another difficulty. They had not only the organized but the unorganized constituents. When they had got rid of the organized, they found an incrustation in the pipes which formed much more rapidly in the recent water supply than in the older. The cause of this seemed very doubtful. When one examined it, it suggested microscopical causes—it might be some nucleus around the iron. It evidently did not arise from corrosion of the inner surface of the service-pipes, but was a direct deposit; and one interesting feature was a varying amount of the substance manganese. With regard to Dr. Kaye's difficulty, it had been found that certain minute organisms (algæ) had on several occasions shown distasteful properties on water; and he suggested that it was due to some such organism as this that the complaint arose. In the West Riding, he had come across one similar case, about nine months ago; and this was due to an organism. It was in a reservoir belonging to the Batley Corporation; and what would happen was a problem for the future. The water was unfiltered, and the life carried down was sufficient to feed the polyzoa in the pipes.

Mr. BURGESS remarked that he was hopeful the paper would strengthen the hands of engineers in inducing their authorities to adopt filtration. No matter what the purity of the original source might be, the water should be filtered before being delivered to consumers. He had seen tons upon tons of mussels taken out of unfiltered water-mains dealing with the Thames supply. Unless these things were quickly disposed of in hot weather, an awful stench arose from them.

Mr. C. H. ROBERTS (Aberdeen) said they had in Aberdeen what was unusual nowadays—unfiltered river water; and it might be interesting to describe what they sometimes got in it. He had sent Mr. Chapman a sample of the water. The contents were certainly heterogeneous—he thought it contained everything under the sun. Aberdeen was well known as a fishing centre; but it was not known that the people annually took their trout from the water-taps. It was a common thing for small trout to come from the taps in the early morning. The lesson to be learnt from the paper was the importance of filtration.

Mr. CHAPMAN, in reply, said a great deal had been written by their medical brethren about odours in water supplies. He had found a fishy odour in the supply at Torquay. They had 260 days' storage, which was quite large enough for the size of the town. He had endeavoured to ascertain what was the cause of the odour, and thought he had been able to place his finger upon it. There were a great number of organisms which lived in the deeper waters of the reservoirs, especially of the class polyzoa; and among these there were a great number that produced within themselves little globules of oil, which were given off after the creatures came to the age of maturity. One class gave off an odour resembling cod-liver oil; and there were seven or eight others which gave off strong, fishy odours. If they could ascertain the number of polyzoa organisms in the water, it would give them some idea as to the cause of the odours which they experienced. As certain known organisms were found at certain known depths, they could avoid them by drawing off the water at different levels.

Coal Tar and Quick Lime for Protecting Iron.

According to the "Bulletin de la Société d'Encouragement pour l'Industrie Nationale" for July, the Brest Military Engineering Department has drawn attention to the satisfactory results obtained with coal tar and quick lime as a protective coating for iron exposed to saline air. The mixture, made in the proportions of 1 part of quick lime to 2 parts of coal tar, is heated to boiling-point in a cast-iron pan and triturated while boiling. The paint is applied hot (40° to 50° C.) with a brush fitted to a handle so that greater pressure can be employed, and consequently a thinner coat of paint given. In this case the paint takes at most two days to dry in warm weather, or with a rather strong wind; but it should never be applied in rainy weather. The weight to use is about 200 grammes (3000 grains) per square metre; and the cost, including labour, is 1 fr. 7 c. per coat. It is applied to new iron over a coat of red lead. In the case of old oxidized iron, the metal must be first scraped and coated with red lead. The first experiment, at the end of 1911, was made on a metal door. After a year there was no trace of oxidation; whereas ordinary paint only resists the action of saline air for about six months. Subsequently numerous applications of the mixture were made on different kinds of ironwork.

Use of Motor Vehicles by Gas Companies.—According to a paper read by Mr. H. R. Cook, jun., of Philadelphia (Penn.), 74 motor vehicles bought in 1911 and 1912 show for the latter year an operating cost of 2·7c. per mile. He says a fair charge for depreciation is 1·5c. per mile, and a fair average life 15,000 miles. They will run, on an average, 35 miles per gallon of gasoline

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Low-Temperature Carbonization under Vacuum.

SIR,—At the time your experts visited and inspected the works of the Tarless Fuel Syndicate at Battersea, and reported so favourably on what they saw,* we were unable to give full and reliable reports on the production of tar oils and their fractions produced by the process. Since then we have carried out some accurate and reliable tests (under the supervision of Drs. Young and Dunstan) on coals and cannels; and I have now much pleasure in sending you the results for publication, as they may be of considerable interest to your readers.

I may mention that the tests were made on some 3 to 5 tons of coal and cannel (per test), and every effort was made to obtain accurate and reliable results, which can be verified at any time, as portions of the coal and cannel have been put on one side for the purpose.

19, *Queen Anne's Chambers, S.W.*,
Aug. 29, 1913. F. D. MARSHALL.

P.S.—The price of fuel placed against the residuals is based on what has been obtained by carbonizing 50 tons of coal per week; and the tar oil residuals have been fixed at the present ruling market prices.—F.D.M.

[ENCLOSURES.]

Stanton Cannel Coal.

One ton of Stanton cannel coal yielded under the tarless fuel process:—

	£ s. d.
14 cwt. tarless fuel at 25s. per ton	£0 17 6
5000 cubic feet of surplus gas, of a value, after stripping-down to 300 B.Th.U., of 3d. per 1000 cubic feet	0 1 3
25·33 lbs. of sulphate of ammonia, at 1d. per lb. net	0 2 1
44 gallons of oil, as per accompanying analysis No. 1	0 13 3
Spirit recovered by compression and gas stripping, as per accompanying analysis No. 2	0 7 11
	£2 2 0
Deduct—	
Cost of cannel coal, estimated at 17s. 6d. London c.i.f. £0 17 6	
Cost of carbonizing coal, including allowance for gas under retort 0 2 6	
	1 0 0
Net value of residuals	£1 2 0

ANALYSIS NO. 1.

44 gallons of water-free oil, sp. gr. ·940.
Water in oil (which has been deducted), 7 per cent.

	s. d.
Light oil, distilled at 170° C. = 6·5 per cent. = 2·9 galls. at 1s.	2 10
Middle oil, 170° to 270° C. = 18 per cent. = 7·9 galls. at 4d.	2 7
Oil above 270° C. (crude lubricating oil) = 27 per cent. = 11·9 galls.	5 11
	11 4
Less 7 per cent. recovered on alkali washing	0 10
	10 6
7 per cent. cresylic acid at 1s. per gallon	3 0
Pitch at 42s. per ton	3 7
	17 1
Deduct cost of fractionating at 1d. per gallon	3 8
Net value of oil	13 3

ANALYSIS NO. 2.

	s. d.
2·6 gallons oil recovered by expansion and compression, sp. gr. ·858, 75 per cent. of which distilled up to 200° C. = 1·95 gallons at 1s. [The sp. gr. of oil distilled between 85° and 150° C. was ·812.]	1 11
The stripping oil—viz., 170 gallons—carried 7 per cent. of light oil boiling below 150° C. with a sp. gr. of ·820. This from 1 ton to 14 cwt. 3 qrs. represented 6·8 gallons at 1s.	6 9
	8 8
Deduct cost of distillation at 1d. per gallon	0 9
Net value of light spirit	7 11

Tyne Boghead Cannel Coal.

One ton of Tyne Boghead cannel coal yielded under the tarless fuel process—

	£ s. d.
14 cwt. of tarless fuel at 25s. per ton	£0 17 6
5000 cubic feet of surplus gas valued at 3d. per 1000 cubic feet	0 1 3
6½ lbs. of sulphate of ammonia	0 0 6
53·5 gallons of oil, as per accompanying analysis No. 1.	1 0 8
Spirit, as per accompanying analysis No. 2	0 4 6
	£2 4 11
Deduct—	
Cost of cannel, estimated at £1 c.i.f. London. £1 0 0	
Cost of carbonizing coal at 2s. 6d. per ton. 0 2 6	
	1 2 6
Net value of residuals	£1 2 5

* See "JOURNAL" for May 20, 1913, p. 514.

ANALYSIS NO. 1.

53·5 gallons of water-free oil, sp. gr. ·9165.

	s.	d.
Light oil distilled at 170° C. = 7 per cent. = 3·8 galls. at 1s. per gall.	3	9
Middle oil (sp. gr. ·832), 170° to 270° C. = 26 per cent. = 14 galls. at 4d.	4	8
Oil above 270° C. (sp. gr. ·886), crude lubricating oil 38 per cent. = 20 galls. at 6d.	10	0
Tar acids, 9 per cent. = 4 galls. at 1s.	4	0
Pitch, 150 lbs. at 42s. per ton	2	8
	25	1
Deduct cost of working at 1d. per gall.	4	5
Net value of oil	20	8

ANALYSIS NO. 2.

	s.	d.
Stripping oil carried 4 per cent. light oil, sp. gr. ·796, yielding 4½ galls. at 1s. per gall.	4	6
Expansion and compression oil yielded 23 per cent. light oils, sp. gr. ·806, yielding 0·43 gall. at 1s.	0	5
	4	11
Deduct cost of working, at 1d. per gall.	0	5
Net value of light spirit	4	6

Bignall Hill Washed Pearls.

One ton of Bignall Hill washed pearls yielded under a temperature of 950° to 1000° Fahr. and under a vacuum of 15 to 20 inches of mercury, with a distillation time of approximately 3½ to 4 hours—

	£		
70 per cent. fine fuel = 14 cwt. at 30s. per ton	£1	1	0
5000 cubic feet of gas, of a value, after stripping-down to 300 B.Th.U. (approximate), of 3d. per 1000 cubic feet.	0	1	3
	£1	2	3
Deduct cost of coal, estimated at 15s. per ton c.i.f. London	0	15	0
	£0	7	3
,, cost of carbonizing per ton, inclusive cost of fuel under retorts	0	2	6
	£0	4	9
Add ammonia, calculated as sulphate, 23·8 lbs. net value	0	2	0
	£0	6	9
,, oils, 22 gallons, as per accompanying analysis, net.	0	6	9
,, spirits recovered by compression and gas-stripping.	0	2	2
Net value of residuals per ton of coal carbonized	£0	15	8

Analysis of the figure 6s. 9d. obtained from fractionating the 22 gallons of oils per ton (condensates)—

Sp. gr. of condensed (water free) oils, 1·060; water, 9 to 9·5 per cent.

	s.	d.
Light oil distilled at 170° C. = 6 per cent. = 1·3 galls. (good for motor spirit solvents, &c.), gross value	1	3
Middle oil distilled at 170° to 270° C. sp. gr. ·970 = 25 per cent. = 5·7 galls. containing about 10 per cent. of valuable tar acids (cresylic acid and homologues), gross value	3	6
Oils above 270° C. A large portion can be obtained, though with some decomposition. Assuming the distillation is stopped when 40 per cent. of bituminous pitch is left, there remains 19 per cent. of heavy oil, sp. gr. 1·04, flash-point 125° C., which is considered a crude lubricant, and which, when refined *in vacuo* will yield—			
4 gallons of lubricant, gross value	2	0	
90 lbs. bituminous pitch	2	6	
	9	3	
Deduct cost of fractionating, &c.	2	6	
Net value of oil condensates	6	9	

Recovery of spirit net value 2s. 2d. by compression and stripping plant.

One ton of coal yielded—

1·2 galls. up to 150° C. spirits of sp. gr. ·818
1·0 ,, ,, 200° C. ,, ,, ·845

Note.—On these spirits, Dr. Dunstan ran a motor cycle with satisfaction 300 miles.

Ash in coal and coke.—Upon analysis the coal was found to contain 5·4 per cent. of ash, and the coke contained 7·4 per cent. ash.

GENERAL REPORT ON TAR AND PRODUCTS FROM THE "TARLESS FUEL" PROCESS.

A tar produced by low-temperature carbonization and under vacuum naturally differs considerably from the tar of the gas-works and in the following respects: (1) Larger amount of light oils. (2) Absence of naphthalene and solid volatile products. (3) Absence of phenol, and presence of a large amount of cresylic acid homologues. (4) Less free carbon and a better quality of pitch.

The chemical nature of the products also shows points of difference in that benzenoid compounds are conspicuously absent, and their place is taken by paraffinoid and unsaturated derivations. The yield of tar is much higher, the light oils would rectify into motor spirit, solvent, and burning oils, the higher fractions contain valuable disinfectants, and when washed from these would fractionate into lubricating oils. They would further serve as excellent creosoting oils.

(Signed) A. E. DUNSTAN, D.Sc. (Lond.), F.C.S.

The "Selas" System of Lighting.

SIR,—With reference to your editorial comments [*ante*, p. 484] on my recent paper given before the Irish Association of Gas Managers in Belfast, perhaps you will allow me a little space to make clear some of the points to which you take exception. I am sorry they were not raised in the discussion which followed the paper, as they could then have been answered. The fact that they were passed over in the discussion seems to point to the conclusion that they were taken in the sense they were intended by the author to convey. In papers of this description, where so much matter has to be compressed into so little space, it is impossible to make oneself as clear as one would wish; whereas, if the author had been able to confine himself to one portion of the subject for his paper, he would have been able to go more into detail, and perhaps avoid a misunderstanding.

The first point you raise is the efficiency of the "Selas" lamps as against high-pressure pure-gas lamps. I think this was fully explained in my paper under the heading of "Greater Efficiency with Smaller Units." Forty candles, or thereabouts, to the cubic foot is the highest ever reached with any high-pressure pure-gas lamp; whereas, 50 to 55 candles per cubic foot is obtained with "Selas" lamp. The reasons, as I explained in my paper, are—firstly, friction at the injector nipple; secondly, weight of air to be moved downwards at a greater rate than that of back-fire; and thirdly, improper mixing in short space between injection and ignition. With the "Selas" mixture, none of these troubles has to be overcome, as, firstly, the friction at the nipple (it being nine times larger than 54-inch gas) is practically *nil*, hence it facilitates the induction of the extra air; and, secondly, the gas and air, after being mixed at the apparatus, mingle more readily with the incoming induced air than is the case with high-pressure gas.

The "Selas" guarantee of 2 cubic feet per 100-candle power is given with a fair margin in hand to allow for low calorific and candle power gases. In actual practice the consumption usually averages 1·7 to 1·9, but never more than 2 cubic feet per 100-candle power yielded anywhere in the British Isles. The "Selas" apparatus enables a rich gas to be taken advantage of with much greater freedom than a high-pressure pure-gas lamp, as with the first the mixture can be set at the apparatus within a couple of minutes, whereas in the latter the nipples have to be changed in all the lamps—*i.e.*, if the candle power of the lamp is to remain the same.

Regarding the candle power of the Manchester gas, I am afraid that the figure you name, taken from the annual report of the Corporation Gas Department, is inclined to be rather on the high side, as, when tested by the author recently, it was somewhere about the figure mentioned. However, I accept the average as stated in the Manchester report. The statement you make of 100 candles being obtained for 1·75 cubic feet, with any properly equipped lamp with pure gas at increased pressure, has never been attained. I have personally tested most British and Continental makes, but have never got anywhere near this figure.

As regards the table giving comparisons of "Consumption of Gas," "Heat Evolved," &c., the column headed "Carbon Dioxide Discharged into Room" was so worded to simplify and to avoid confusion. It means the whole of the products of combustion, foul gases, mixed gases, or whichever of these more or less erroneous terms under which they could be classified for the purpose of simple comparison, may be employed. The percentage, which is the main object, is, of course, correct, and remains so no matter what the candle or the calorific power of the gas may be. As to our electrical friends making capital out of this table, I do not think this can happen, as it is well known what is the amount of actual carbon dioxide in a cubic foot of gas, and conclusive proof has been given by high authorities that gas for general lighting is far preferable to electricity.

A. DOCKING.

Manchester, Aug. 25, 1913.

[We are afraid that the explanations of our correspondent will not carry complete conviction. In the first place, he must not assume that because the points raised in our comments were passed over in the discussion at the Irish meeting, this "seems to point to the conclusion that they were taken in the sense that they were intended by their author to convey." We suggest, too, that it would have been better to have compressed less matter into the space available in the paper rather than to have sacrificed clearness. However, we certainly cannot accept any such *ipse dixit* assertion as that 40 candles or thereabouts to the cubic foot is the highest efficiency *ever reached* with any high-pressure pure-gas lamp; nor the still more dogmatic assertion that the efficiency represented by 100 candles for 1·75 cubic feet has "never been attained." The manner in which this is stated in the above letter is tantamount to declaring that our statement was a falsehood. We are not prepared to accept Mr. Docking as the judge as to whether or not we are to believe our own senses, nor are we prepared to accept his photometrical work as finality itself under all circumstances and with all sorts of lamps. The stated efficiency has been obtained, and by photometrists of high reputation and disinterestedness, both professionally and commercially. The gas industry knows this. Many important gas undertakings, to our knowledge, have also made tests of various high-pressure gas-lamps, with better results than Mr. Docking ascribes to them. Consequently, we are afraid that competent men will look upon the present critic's findings as containing a certain amount of bias. The reasons why the Selas lamp is supposed to do so much better than the high-pressure gas-lamps are rather curious at this time of day. The first is friction at the injector nipples of high-pressure gas lamps. Does our correspondent imagine that, with all the experience that has accrued in the making of injector nipples, "friction" is now such a terrible factor in depreciating efficiency? Then there is the "weight of air to be moved downwards at a greater rate than that of back-fire." This is a bit ambiguous; and, as we did not limit

Mr. Docking to space in his reply, he might—taking into consideration the conditions existing in high-pressure gas-lamps—have made his point a little clearer. We did not want to mention any lamp; but we would suggest that he should take, for example, the conditions existing in the Keith lamp, with the effects wrought upon the mixture by the heating chamber, in making his explanation of the point. His discussion of it will perhaps also bring a little enlightenment as to why he thinks (with that lamp) there is "improper mixing in short space between injection and ignition." There is a looseness in parts of our correspondent's diction which will not assist to clear understanding by any of our readers who have not had an intimate experience of high-pressure gas-lamps. For instance, speaking of friction at the nipple, he explains that this trouble is not experienced at the Selas nipple; "it being nine times larger than 54-inch gas" [*sic*]. We know what is meant; but the looseness is not instructive to those who do not. The Manchester Corporation Gas Department will be interested to know that Mr. Docking is inclined to think that the average of their official tests last year is rather on the high side. But probably the experienced officials responsible for the tests will make some allowance for his view, seeing that he is inclined to believe that the work of photometrists generally within the limits of this discussion, other than his own, errs on the high side. We cannot excuse our correspondent for the heading to the column in the table of which we complained, "Carbon Dioxide Discharged into Room." To say that this was so worded "to simplify and to avoid confusion" is not at all satisfactory. The so-called simplification was the best of possible routes to confusion. Our electrical friends are in the habit of quoting to the general public (who do not know much, if anything, of these matters) even mis-statements of authors as being authoritative, so that it is well not to simplify statement in technical matters at the expense of truth. We repeat that the table in question should be withdrawn or else made absolutely clear.—ED. J.G.L.]

Gas and Air Adjusters for Gas-Fires.

SIR,—We notice that Messrs. Wilsons and Mathiesons claim the introduction of gas and air adjusters, and refer in this respect to the issue of the "JOURNAL" for Nov. 7, 1905.

We have had many patents in the gas apparatus industry, but we are not for the moment intending to trouble to refer to them specifically. Among our patents, however, is the following: No. 13,108, of June 10, 1904, for "improvements in and relating to gas-burners for heating and lighting." This patent, with the drawings attached thereto, clearly shows the introduction of our air and gas adjuster; and the date speaks for itself.

CANNON IRON FOUNDRIES, LIMITED,
per RICHARD CLAYTON, Chairman.

Deepfields, near Bilston, Aug. 25, 1913.

Chichester Gas Company.

Presiding at the half-yearly meeting of the City of Chichester Gas Company, Mr. W. A. Walker said that in the past six months there had been an increase of slightly over 2 per cent. in the sales of gas, and 89 new consumers had been secured. The total expenditure had increased by £337, and the gross receipts by £342. Every class of material used by the Company had in the last eighteen months or two years gone up to the extent of 15 or 20 per cent. They had, however, benefited from good working results, having sold close upon 11,000 cubic feet of gas per ton of coal carbonized. He alluded in complimentary terms to the efforts of the staff. The report was adopted, and dividends for the half year were declared, less income-tax, at the rates per annum of 8 per cent. upon the "A" capital stock, and £5 12s. per cent. upon the "B" and "C" capital stocks.

Southend Gas Company.

At the half-yearly general meeting of this Company last Tuesday, the Directors reported an increasing demand for gas; the quantity sold in the half year ended the 30th of June being 192,437,700 cubic feet, which, compared with the corresponding period of 1912, equalled 2·32 per cent. increase. The number of consumers was 16,578, or 486 more. The usual increase in the number of cooking-stoves and fires had been more than maintained, and special attention had been directed to the sale of geysers, hot-water circulators, and other appliances, with very satisfactory results. The profit for the half year, after payment of interest charges, was £7676. This added to the balance brought from the last account amounted to £10,620; and the Directors recommended the payment of dividend on the original consolidated and new ordinary stocks at the rate of 5⅛ per cent. per annum, and on the new ordinary "B" stock at the rate of 5½ per cent. per annum (all less income-tax). This would absorb £7951, and leave £2669 to be carried forward. The report of the Engineer and Manager (Mr. F. Clark) showed the additions which had been made to the mains, bringing up the total length to 76 miles 842 yards. Mr. Clark stated that all the public lamps had been converted from the upright to the inverted burner, and were giving one-third more light. The Chairman (Mr. C. F. Woosnam), in moving the adoption of the report, made some interesting comparisons of the figures in the accounts with those for the first half of last year, and alluded to the present price of oil and coal. Mr. J. Randall seconded the motion, and it was carried.

The Richmond Gas Stove and Meter Company, Limited, have just completed the installation of a suite of gas-cooking apparatus for the Royal Naval Training College, Osborne House, Isle of Wight.

REGISTER OF PATENTS.

Pyrometers, Gas Analysis Apparatus, &c.

ARNDT, M., of Aachen, Germany.

No. 15,019; July 1, 1912. Convention date, June 30, 1911.

This invention relates to apparatus for measuring a predetermined quantity of air or gas in instruments—such as pyrometers, apparatus for analyzing gas, and the like—acting either at atmospheric pressure or at a pressure above atmospheric, in which a liquid subjected to pressure controls a float which, when a certain pressure obtains, shuts off the pressure medium by a valve, and in this manner renders any increase or decrease of the pressure inoperative on the quantity of air or gas which is trapped.

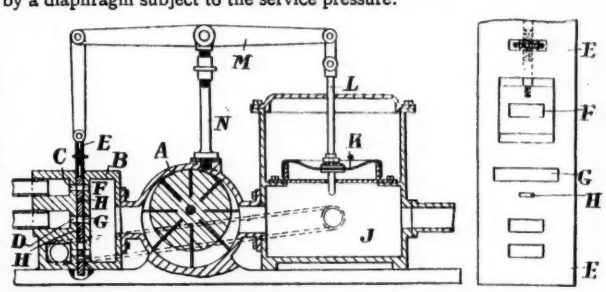
The invention is characterized by the arrangement of the float and valve at a certain part of the apparatus—the float being arranged in the chamber containing the quantity of air which is to be compressed or trapped, and the valve in the ascending pipe leading to this chamber. The object of the invention is to measure off automatically a definite volume of air or gas to be pressed periodically by means of a column of liquid, for the purpose of a measuring operation, in an instrument of the kind in question, by arranging a float within a chamber that receives the volume of air or gas to be pressed in, and which float acts in such a manner that the further access of the pressure liquid to the chamber and to a super-pressure pipe connected with the latter is prevented by the float, with the help of a valve, as soon as the volume of liquid forced into the float container is equal to the volume of air or gas required to be forced in for the measuring operation. The float is constructed as a valve, so that, like the valve already referred to, it shuts off the inflow or outflow of liquid, and also with the pressure above atmospheric closes the air outlet.

Mixing Gas and Air.

GUY, F. H., of Nottingham.

No. 17,970; Aug. 3, 1912.

In this mixer, for example of coal gas and air for lighting or heating purposes, the inlet valve which regulates the proportions of air and gas admitted is of the slide-valve type, and is connected to and controlled by a diaphragm subject to the service pressure.



Guy's Gas and Air Mixer.

The illustration shows a sectional elevation of apparatus and an elevation of the slide-valve.

An ordinary rotary air compressor A has its exhaust side connected to a valve casing B, provided with a gas-inlet port C, and an air-inlet port D—both controlled by one slide-valve E sliding within the valve casing. The valve is provided with corresponding openings F and G—for gas and air respectively.

In order to provide means for conveniently regulating the proportions of gas and air from time to time, one of the ports F in the slide-valve E is formed in a part which is adjustable in an opening in the body of the slide-valve. This part is adjusted by a screw attached to the part, carried up to an adjusting nut in a slot and in that part of the valve which is above the valve casing B in which the valve works, so that the adjustment can be made without removing the valve.

In addition to the two ports described, there is a third port H in the slide-valve near the air-inlet port G, which is provided for the purpose described later on.

The outlet side of the compressor is connected to a service chamber J; and above it is a second chamber in which there is a diaphragm K, the underside of which is connected to the chamber J, and is thus subject to the service pressure.

The stem L of the diaphragm, which is carried out above the diaphragm chamber, is connected to the slide-valve E by means of a lever M pivoted to a pillar N, and links, so that the movements of the diaphragm are imparted to the slide-valve E, and the proportions of air and gas admitted to the compressor are automatically controlled.

When the diaphragm K is in its intermediate position (as shown), both inlet ports C and D are fully open; but, as it rises to its maximum height, it moves the slide-valve E downwards and closes them to a more or less extent. On the other hand, when the diaphragm falls to its lowest point (when the compressor A is stopped), the slide-valve E is moved far enough in the reverse direction or raised sufficiently to close the two inlet ports C D again, so that the gas is automatically cut off, and cannot leak through the apparatus if the attendant should omit to turn it off.

When the inlet ports C D are closed, the apparatus would not of itself start again, unless provision were made for the admission of air to raise the diaphragm again. The opening H in the slide-valve E is provided for this purpose—being so disposed that when the diaphragm falls to its lowest point, and closes the gas-inlet port C, this opening H is moved into register with the air-inlet port D. It thus provides an air inlet, which is closed as soon as the slide-valve has moved far enough to bring the main opening into operation.

Packing of Socket-and-Spigot Pipe-Joints.

SCHOMBURG, L., of Gelsenkirchen, Germany.

No. 18,503; Aug. 12, 1912. Convention date, Nov. 13, 1911.

This invention relates to the testing of the packing in socket-and-spigot pipe-joints.

According to patent No. 24,117 of 1911, there is provided behind the packing a hollow space, shut-off fluid-tight by auxiliary packing, and with which space a pump can be connected, in order to test the packing by means of air under pressure or compressed gas. According to the present invention, instead of air or gas under pressure, a liquid is used for testing, which is adapted to serve also as a packing-material in the joint.

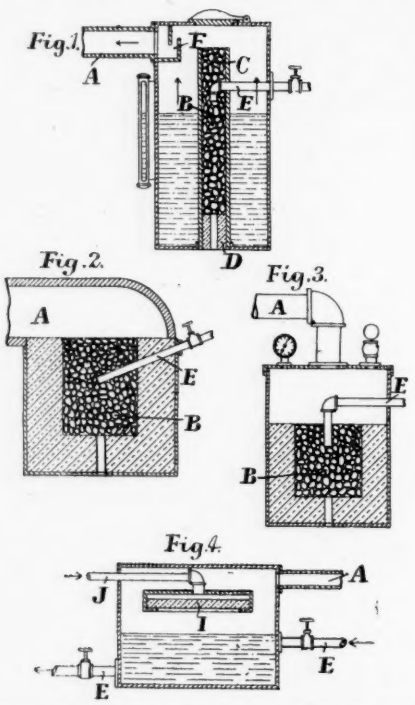
The employment of such a liquid has, it is said, considerable advantages. Packings of tarred rope or like material have been found in practice to become more or less dry after some time, and then no longer keep tight. If now a test be made by means of a liquid—such as oil, glycerine, or the like—introduced under pressure into the hollow space between the packings, the packing will be thereby moistened and will close up again perfectly. If the first test on laying be also made with liquid under pressure, an impregnation of the packing lasting for a long time will be obtained. The testing is preferably effected in such a manner that the liquid is left in the hollow space, and is only put under pressure again when a new test is to be made. The liquid enclosed in the hollow space then also acts as a packing itself, and keeps the packing-material permanently moist. Finally, the liquid introduced can be drawn out of the hollow space again at any time, for which purpose a flexible pipe is introduced and the test then made with air or gas.

Producing Mixtures of Heated Gas or Vapour and Products of Combustion.

M'COURT, C. D., of Streatham Common, Surrey, and ELLIS, C., of Montclair, New Jersey, U.S.A.

No. 25,627; Nov. 8, 1912. Convention date, Jan. 4, 1912.

This invention has relation to the production of mixtures of heated gas or vapour and products of combustion—especially suitable for the distillation of heavy oils. The well-known Bone, Wilson, and M'Court surface combustion method (as modified) is utilized for the production of the heated gas or vapour directly in or on the combustion bed or beds and not through an intervening solid body, and the desired mixture being formed by the admixture of the heated gas or vapour with the products of the combustion.



M'Court and Ellis's Applications of Surface Combustion Methods.

The illustration shows embodiments of apparatus for carrying out the invention—it being assumed that it is desired to produce a mixture of superheated steam and products of combustion.

Referring to fig. 1, the discharge pipe A leads the mixture of superheated steam and products of combustion to the apparatus in which the mixture is to be used, and is connected with a metallic or other casing provided, at its upper portion, with an igniting and inspection orifice closed by a hinged door. B is refractory material—such as fire-clay or calcined magnesite, in granular or fragmentary form, packed within tubes C, mounted substantially vertically. Their upper ends are open and their lower or inlet ends are filled with plugs D of refractory material, each having one or more passages through it, and serving for the introduction or injection of combustible mixture among the refractory material. Water is sprayed among the heated refractory material in the upper portions of the tubes through pipes E, the ends of which are above the zone of active combustion and are provided with spraying ends located centrally of the tubes and, preferably, extending downwards. The liquid discharged into contact with the heated refractory material is vaporized, and the vapour is superheated; while further superheat is imparted to the gas or vapour as it becomes mixed with the highly heated products of combustion rising through the upper part of the bed of refractory material. The products of combustion and superheated steam are usually sufficiently mixed during their passage through the pipe A; but, if desired, baffling means, such as F, may be provided in the mouth of the pipe to ensure a more homogeneous mixture. Liquid is also contained in the casing and surrounds the tubes C. The heating of this liquid utilizes heat transmitted through the walls of the tubes; and the resulting gas or vapour is superheated by admixture with the gas or vapour and products of combustion issuing from the mouths of the tubes.

Referring to fig. 2, the discharge pipe A is connected with a casing lined with firebrick or other refractory material, and the furnace chamber so formed is filled to the desired extent with refractory material B in granular or fragmentary form and, preferably, of substantially uniform size. The combustible mixture is introduced and combusted in the bed of refractory material as before described, and liquid is sprayed or discharged from a pipe E into the bed of heated refractory material, preferably above the point at which the combustion of the combustible mixture is substantially completed. The liquid discharged into contact with the heated refractory material is vaporized, and the vapour is superheated; while further superheat is imparted to the gas or vapour as it becomes mixed with the highly heated products of combustion rising through the upper part of the bed of refractory material. A substantially uniform mixture of gas or vapour and products of combustion is said to be formed in this manner.

Fig. 3 shows an arrangement substantially similar to fig. 2, but especially adapted for delivering the mixture of gas or vapour and products of combustion at a higher pressure than is possible with the former arrangement. For this purpose, the casing is made stronger and is provided with a pressure gauge and a safety valve G, so as to observe and regulate the pressure of the superheated mixture delivered to the discharge pipe. The furnace chamber or container is formed by the refractory lining of the casing.

In fig. 4, the metallic casing is provided with a discharge pipe A, and with a liquid inlet pipe E controlled by a valve. H is the liquid outlet pipe controlled by a valve. The liquid admitted to the casing is heated and evaporated to the desired extent by the surface combustion of combustible mixture in such a manner as to heat locally the upper surface of the liquid. This is accomplished by the use of one or more diaphragm surface combustion units I, "disposed so as to act properly on the liquid." The diaphragm units are formed, in manner well known, of granules or particles, small and substantially uniform in size, of fire-clay or other suitable refractory material fritted or calcined sufficiently to consolidate them into a coherent diaphragm, 1 or 2 inches (2·5 cms. or 5 cms.) thick, and having sufficient porosity to permit the combustible mixture to pass through at the desired rate. When combustible mixture is forced through the pipe J, it emerges from the outer face of the diaphragm where it may be ignited. The combustible mixture burns on the outer face of the diaphragm, and heats it sufficiently to cause the surface combustion of the combustible mixture to occur within the outer layer of the diaphragm, and bring its exposed surface up to incandescence.

Trolley Arms used in Telphers, &c.

R. DEMPSTER AND SONS, LIMITED, and BROADHEAD, J. W., of Elland.

No. 24,263; Oct. 24, 1912.

This invention relates to trolley arms in which springs are employed to keep the arm in contact with the cable or conductor. It is intended to provide for the automatic release of the springs when the trolley is released, so that the trolley may fall rather than rise. For this purpose, the springs connected at one end to the butt-end of the trolley arm are connected at the other end to a hinged plate, engaged by a pivoted catch. The action of the arm, when pressed down by the overhead cable, is to keep the hinged plate in engagement with the catch; but as soon as the trolley arm is released and rises, the hinged plate is thereby allowed to drop, and disengages the pivoted catch. The arm then falls, lifting the hinged plate to the extent permitted by suitable fixed stops or buffers.

Gas-Engines.

MOWBRAY, J. W., and CHAMBERS, J. H., of Winnipeg, Canada.

No. 25,244; Nov. 4, 1912.

This invention relates particularly to a two-cycle gas-engine "wherein an absolutely uniform torque is ensured throughout the entire revolution, and wherein there is very little vibration caused by the shock of the explosion." A further object is to provide an engine wherein the spent gases are ensured of being replaced by the incoming live gas or charge at the point of firing previous to the charge being fired.

The patentees claim: In a two-cycle gas-engine, the combination with a cylinder, a combination crank casing and compressing chamber secured to the cylinder, and a reciprocating piston within the cylinder, of a bye-pass opening to the side of the cylinder at the bottom and to the top of the cylinder at the top—the bye-pass gradually increasing in cross sectional area from the lower end to the top, and having an ignition plug located in the bye-pass towards the lower end of it.

Gas-Engines.

BLOSE, C. S., of Palmerton, Pennsylvania, U.S.A.

No. 1294; Jan. 16, 1913.

This invention relates to improvements in two-cycle internal combustion engines, in which the piston is adapted to over-run ports controlling the admission of air to the crank case. The supply of air when compressed to the engine cylinder and the exhaust of the burnt gases (more particularly to engines of this type which are provided with a fuel-supply device) comprises a fuel bowl which is fitted with a float-

controlled inlet valve, a feed-pipe leading to a nozzle arranged in the air-inlet port of the cylinder, and which bowl is subjected to the fluctuations of pressure in the crank case so that oil is alternately drawn into the fuel bowl and forced through the nozzle into the cylinder.

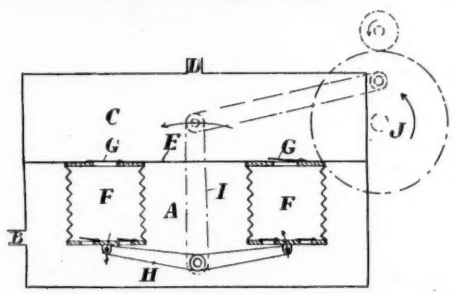
The pressure connection between the fuel bowl and crank case, instead of being constantly open, is intermittently interrupted—for instance, the pressure pipe is led to the known bye-pass passage leading from the crank case to the air-inlet port in the cylinder, and the bye-pass communicates with the crank case by a port controlled by the piston. The arrangement is such that the fuel bowl is placed in connection with the crank case during the latter part of the upward movement of the piston, and, for a very short period, at the end of the downward stroke. By this means, a sufficiently long period of suction or low pressure exists in the fuel bowl to ensure admission of fuel to it, and a brief period of high pressure which will cause the required sudden feed of fuel to the cylinder. There will thus be no unnecessary and continuous agitation as would occur with a continuously open connection between the fuel bowl and the crank case.

Gas Compressors.

MacArthur, A., of Johnstone, N.B.

No. 5093; Feb. 28, 1913.

This appliance is for compressing gas to be consumed in internally-heated laundry irons, gas-fires, gas-lamps, &c., and is of the type in which bellows are employed to compress the gas.



MacArthur's Gas Compressor.

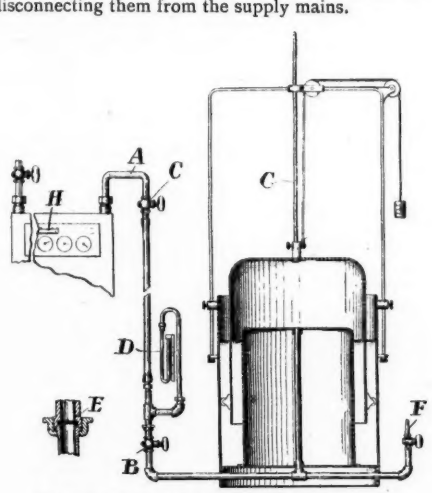
As shown, the compressor comprises a chamber including a compartment A, into which gas is led through an inlet pipe B, and a storage compartment C having an outlet pipe D—there being disposed between the compartments A and C a partition E. Arranged within the lower compartment is a pair of bellows H consisting of flexible side members closed at their upper and lower ends by plates; the top ones serving as seats for exhaust flap valves I, disposed over perforations formed therein and perforations formed in the division plate, and the bottom ones affording seats for similar inlet valves over similar perforations. The end-plates are secured to the partition, and the plates are movable axially of the bellows. By reciprocating the end-plates, gas will be drawn through the pipe B into the compartment A, through the inlet valves to be compressed in the bellows, and forced through the exhaust valves into the storage compartment C, thence through the pipe D to the point where the compressed gas is to be consumed. Reciprocatory movement is imparted to the end-plates of the bellows by a rocking-bar J, connected to the plates and strung on a rock-shaft journalled in the casing of the compartment A. To the shaft is keyed a swinging lever K, operated through the intermediary of a connecting rod by the crank pin of a gear-driven crank disc L.

Meter-Testing Apparatus.

Dezendorf, R. L., of Richmond Hill, New York State.

No. 11,090; May 10, 1913.

This apparatus is for testing meters on the premises of customers without disconnecting them from the supply mains.



Dezendorf's House-Meter-Testing Apparatus.

The method of testing meters by means of the invention is as follows: The supply of gas is first cut-off from the meter by the stopcock on the inlet connection; and the outlet connection with the meter is disconnected from the house system. The coupling A is then applied to the outlet connection, and the meter stopcock opened to permit gas to go through the meter. The lower stopcock B is closed and the upper stopcock C is opened. Gas under pressure then flows to the gauge D. The connections are then tested to see if they are tight. The inlet cocks A and B are then fully opened, and the stopcock C is adjusted so as to make the pressure indicated at the gauge the desired pressure for the test depending upon the size of the opening in the disc E and the adjustment of the cock C.

Some gas is next allowed to enter the bell, after which the stopcock B, which now becomes the operating cock, is closed, and the discharge port F is opened so as to permit the gas (and air, if any) within the bell to escape, and also to set the bell. When the bell has descended to the desired starting point, as indicated by the scale G, the vent F is closed and the position of the revolution indicator H of the meter observed. The cock B is then opened to permit gas to flow through the meter and into the bell. The indicator is then again observed, and, when it has made one complete revolution, the stopcock B is immediately closed. A reading of the scale G is then taken, whereby the distance which the bell has moved can be determined. If this movement corresponds to what it should be for one complete revolution of the indicator, the meter tested has registered accurately. If the bell is too high, the meter has failed to register the full amount of gas which has passed through it; and if too low, the meter has over-registered.

APPLICATIONS FOR LETTERS PATENT.

18,705.—Harris, J. H., "Compound for treating coal and like fuel." Aug. 18.
18,725.—Lillie, J. A., "Pipe-joints." Aug. 18.
18,730.—Bousfield, J. E., "Valve." A communication from Julius Pintsch Akt.-Ges. Aug. 18.
18,734.—Hall, W. A., "Fuels for internal combustion engines." Aug. 18.
18,736.—Shannon, J., and Hammond, F., "Water-heaters." Aug. 18.
18,744.—Pierrard, J. D. J., "Gas-fittings." Aug. 18.
18,745.—Wilkinson, G., "Storing dissolved acetylene gas." Aug. 18.
18,774.—Rotherham, E., "Anti-vibrator." Aug. 19.
18,822.—Smith, W., "Manufacture of fuel." Aug. 19.
18,824.—Julius Pintsch Akt.-Ges, "Connecting gas-lamps." Aug. 19.
18,832.—Moore, M., "Outlet-regulators for gas-fittings." Aug. 19.
18,931.—Altenhein, E. F., and Wilson, L., "Gas-burners." Aug. 20.
18,974 —Jones, W. H., "Hydrant or syphon boxes." Aug. 21.
18,982.—Flynn, F. W., and Marley, F., "Controlling the lighting and extinguishing of gas." Aug. 21.
18,995.—Yates, H. J., "Gas-fires." Aug. 21.
19,168.—Dickinson, T. J., "Spanner or screw key for gas or water pipes." Aug. 23.
19,169.—Humphrey, H. A., and Rusdell, W. J., "Raising or forcing liquids." Aug. 23.

Cork Gas Consumers' Company.

The 89th meeting of the Cork Gas Consumers' Company was held last Thursday, when the report submitted stated that the accounts showed a small increase in the rental; and after placing £100 to the insurance fund and £1687 to the depreciation fund, the balance to profit and loss was £5507. Payment was recommended of the ordinary dividend at the rate of 8 per cent. per annum, and 1s. per share as supplementary to the dividend, for June 30, 1901, on the paid-up capital at that date—the dividend then being at a reduced rate. The payment proposed amounted to £6884; and to meet this £1377 would be taken from the reserve fund. The Chairman (Mr. G. Lynch), in moving the adoption of the report, said they were glad to have so favourable an account of the Company's business, and glad also that they were able to make a beginning in the payment of arrears of dividend so long due. As to future instalments, they could not bind themselves; but they would act for the best, consistently with the Company's interests. For the many different purposes for which it was used, the popularity of gas was still more than maintained. Beside lighting, there was a continuous increase of consumption for cooking and heating. The demand for gas as a motive power showed that its efficiency was recognized by those requiring an economical and effective form of energy. Within the past year, several engines had been installed for various purposes. As an economical mode of obtaining electric light, the gas-engine had been found to give special satisfaction. So far as they in Cork were concerned, the steadily increasing demand for gas left them no anxiety as to the future. The report was adopted, and the dividend declared.

The Proposed Gas-Works Purchase at Farnworth.—In moving the adoption of the report and balance-sheet at the half-yearly meeting of the Farnworth and Kearsley Gas Company last Thursday, Alderman James Fletcher, J.P., said the increase in the make of gas was an indication of the progress of the undertaking. The cost of coal and other materials had gone up; and with these adverse conditions it was all the more satisfactory that they were in a position to reduce the price of gas. They had been enabled to take this step owing to increased efficiency in the manufacturing department. As to the proposals of the District Councils to purchase the undertaking, and the permission which had been given to their expert to visit the works, the Chairman remarked that, though at one time he was in sympathy with this proposal, he ventured to think that at the present it was inopportune, and would not for many reasons be beneficial to the consumers. The report was adopted, the usual dividends of 10 and 7 per cent. were declared, and the Board were thanked for their services.

MISCELLANEOUS NEWS.

AUSTRALIAN GASLIGHT COMPANY.

The Annual General Meeting of this Company was held at the Royal Exchange, Sydney (N.S.W.), on the 28th of July—Mr. G. J. COHEN (the Chairman) presiding.

The SECRETARY (Mr. R. J. Lukey) having read the notice convening the meeting, the Directors' report (*ante*, p. 562) was taken as read.

The CHAIRMAN, in moving the adoption of the report, said: I am sorry that for the third half year in succession I have to report that the Company have passed through a period of great anxiety, felt all the more severely on this occasion owing to the unexpected action of the workmen in breaking the existing industrial agreement by going out on strike on Feb. 28—thus for a time paralyzing the Company's business and causing the public great inconvenience and loss through being deprived of the gas supply for a week.

THE LATE STRIKE.

Contrary to the intention of those in charge of the Bill, it was found when it became law that it contained no provisions for agreements other than those under the "Industrial Arbitration Act, 1912, or any Act amending the same;" and this was fully borne out when the matter was referred to the Arbitration Court. But, instead of again approaching the gas companies when Judge Heydon's decision was given against them, the men, without any notice, so far as this Company were concerned, left the works. So matters stood until the Premier intervened, and requested a conference of representatives from both sides, the ultimate result of which was the resumption of work, and arrangements for the appointment of a Wages Board whose award was given on June 8 last. This practically conceded all the men's claims regarding wages, the additional cost of which to this Company has been estimated at about £30,000 per annum. The Gas Act, 1912, provides for increasing the standard price of gas, which we shall endeavour to obtain when we are in a position to present the necessary figures to the Court. Before passing away from this subject, I should like to refer to the sympathy and practical support received from the citizens who came to the help of the Company at a most critical time, and, together with the staff (whose loyalty was much appreciated), very materially assisted in maintaining the fires and the manufacture of gas until work was resumed.

CLAIM AGAINST THE GOVERNMENT.

I exceedingly regret being unable to report any progress towards a settlement of the Company's claim against the Government for the resumption of the Head Station. As you are already aware, the amount decided upon some time ago was set on one side with a view to the matter being brought before the Court. The delay in coming to an agreement, and our receiving part payment on account of the claim, is causing the Company great inconvenience. The matter is, however, receiving further attention from us, as I understand the Government are now anxious to have the question settled. I trust this will be brought about, as, in anticipation of our removal to Mortlake within the time specified, a very large amount of money has been spent, and contracts let for a gasholder, retort-house, and other necessary gas plant, together with the new 36-inch main from Mortlake to connect with the city, which has involved the Company in very heavy commitments. I might mention that the holder is much larger than the one it will displace at Jenkins Street; but we are taking advantage of the position to meet future demands. The holder will have a capacity of 12 million cubic feet of gas, and will not only be the largest in the Commonwealth, but the third largest in the world. The Sydney Harbour Trust Commissioners have taken full advantage of the agreement mutually entered into by them and the Company; and great strides have been made in the erection of one of the wharves in front of the Company's works. We are endeavouring, to the best of our ability, to meet the Government's wishes for us to give up possession of our Kent Street works as soon as practicable.

QUALITY OF THE GAS SUPPLY.

Comment has been made in the daily Press of late regarding the quality and supply of gas. I can assure you that the illuminating and calorific power have been fully maintained. I admit that for a few nights in the earlier portion of the evening, when gas-cooking was in full swing, the usual pressure dropped somewhat; but both as regards light and pressure the Company have far exceeded what is provided for in the new Gas Act. The fact of the matter is that many consumers have the impression that, when once gas has been installed in a house, no further attention is necessary, no matter how long the fittings have been in use; and, in consequence, if anything goes wrong, they blame the Company for it. During the past few weeks, I have had submitted to me cards showing the pressure at the houses of several of our consumers who have long been making complaints against the Company, while all the time the defects were in the private fittings, over which, of course, we have no control. It may be of interest to you to know that, in order to meet the increasing demand for gas, the Board have sanctioned extensions of mains at a cost of over £50,000. These it is expected will be laid before next winter.

GROWTH OF BUSINESS.

Owing to the phenomenal prosperity Sydney has enjoyed during the past four years, the Company, like other large public institutions, have found it difficult to anticipate the requirements of their customers, as for many years previously increases were only normal. This, you will readily understand, when I point out that the consumption has grown from 2,314,880,000 cubic feet in 1909, to 3,266,700,000 cubic feet for the year ended June 30 last—an increase of over 40 per cent. In the past, the Directors have been severely handicapped for want of capital to provide for extensions as quickly as they could have wished. Now these restrictions have been removed, the Company can raise the necessary capital required for the carrying on of the business. Presuming that this increase will continue—and I have no reason for thinking otherwise—the Directors have already sanctioned a large outlay in order to provide for it. On reference to the report, you will notice that the capital now stands at £1,530,000; the increase being due to the issue of 42,500 "C" shares at £6 each, as recently authorized by the proprietors. The Directors have appointed the Chairman and Secretary to hold in trust the allotments of shares made to shareholders residing outside the Commonwealth; the time for payment of the purchase-money having been extended to Oct. 1 next, as provided in the resolutions passed when the shares were created. I would like to state again that the dividend on these "C" shares, or any future creation of shares, cannot exceed 7 per cent. per annum, unless the gas is reduced in price below the standard rate, when, for every 1d. reduction, the standard rate of dividend may be increased 5s. per cent. As already intimated, the increasing consumption of gas year by year has been exceedingly gratifying, particularly in face of the competition of electricity. The shareholders can look forward to the future with every confideuce. The day consumption shows a steady increase, due doubtless to gas engines, cookers, and the many labour-saving appliances. It is now equal to 52 per cent. of the total sales. With regard to gas-cookers, in particular, the number sold during the half year was 2100; the total disposed of by the Company being 31,177. There is a slight falling off in the number of public lights, due to the adoption of electricity; and this will doubtless continue while the Municipal Councils indulge in what they term the "up-to-date light," which is a misnomer, as has been conclusively proved by the greatest experts. No light yet produced can favourably compare with gas, particularly under the high-pressure system of lighting. The public lights now number 9334. The consumers show an increase of 3791 for the half year; the total number on the books being 111,651. To meet the demand for gas, the Company have laid during the period under review 90 miles of mains and services; the total mileage being now 2839.

THE COMPANY'S NEW POWERS.

The present form of presenting the balance-sheet to the proprietors will cease with this meeting, and that contained in the Gas Act will take its place. One of the most satisfactory clauses of the new Act is that relating to the testing of meters, which the Company have long desired. If in future the consumers have any reason for doubting the correctness of their accounts, they can appeal to the public tester, in whose hands this important duty is now reposed. The Company's Charter was granted in 1837; and many interesting facts could be related in connection with its rise and progress. But time will not permit. I may say, in passing, however, that during this period the price of gas to private consumers has been reduced from 25s. to 3s. 6d. per 1000 cubic feet, and the public lamps from £10 to £3 15s. per lamp per annum. Only twice during the 76 years the Company have been in existence has the price been raised—the last occasion (1890) being for three months only. In evidence of the rapid development of the Company, I would point out that in the first year the sale of gas was 12,000,000 cubic feet, the revenue from all sources being £12,125, compared with this year's sale of 3,266,700,000 cubic feet, with a revenue of £682,156.

The report was adopted, a dividend for the half year at the rate of 10 per cent. per annum on the "A" and "B" shares was declared, and the retiring Directors and Auditors were re-elected.

Thereafter the Directors, officers, and staff were thanked for their efficient services.

BARNET DISTRICT GAS AND WATER COMPANY.

A Gratifying Statement.

The Half-Yearly Meeting of this Company was held last Friday, at the Holborn Restaurant, W.C.—Mr. ALFRED H. BAYNES, J.P., in the chair.

The SECRETARY (Mr. Ernest W. Drew, F.C.A.) read the notice convening the meeting; and the Directors' report and the accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said he would not detain the shareholders for any length of time, but there were a few observations he would like to make as to the results achieved during the past half year. It would be seen from the accounts that there had been considerable capital expenditure during the six months to June 30. For gas, the amount was £6240; and on water account, £4508. This outlay was principally due to the development of the Company's district at the extreme limits of the areas of supply. They had laid over 10 miles of additional mains; the total lengths now being 74 miles of gas and 164 miles of water mains. Apart from the mains, the only other capital expenditure of importance was £1700 on account of the plant at the Tyttenhanger pumping-station. Dealing first with the revenue account of the gas department of the business, the receipts from the sale of gas showed an increase of £1000. The rentals for meters and stoves and the receipts for residual products also exhibited small gains; the total increase on this side of the gas revenue account being £1154. Expenditure on the manufacture of gas amounted to £9418, which was £433 more than in the corresponding period of the previous year; the increased make being just over 5 million cubic feet, or 5½ per cent. At the same time, the gas sold showed an increase of very nearly 7 per cent. He might here draw attention to the excellent carbonizing results that had been achieved—the make of gas per ton of coal carbonized amounting to 13,761 cubic feet. There was a reduction in the unaccounted-for gas of nearly 1 per cent.; and the quantity of gas sold per ton of coal was 13,025 cubic feet. They had sold nearly 6 million cubic feet more gas than in the first half of last year, while the cost of coal, oil, &c., had been £132 less. The outlay on distribution had been £373 more, which was due to increased expenditure on the renewal of mains, services, and stoves, and to the augmented

business of the Company. Public lighting expenditure was also up £148. The other items of gas expenditure did not call for special mention. The net result was that the amount carried to profit and loss account was £4556, which represented a slight increase over the same period of 1912. As to the water department, the total receipts for water, after deducting empties and allowances for bad debts, showed the very satisfactory increase of £1631. The total expenditure for water had been £9852. This was £382 more than in the corresponding period—due to additional cost of pumping and engine charges. The balance on account of water revenue carried to profit and loss was £13,047, or an increase of £1249. Turning now to the profit and loss account, the credit balances carried from the gas and water accounts, including a profit of £236 on fittings, amounted to £17,840. Charges for income-tax and interest came to £2788, and £2000 had been transferred to the contingency fund. The balance of net profit for the half year, together with the amount brought forward from the previous half year, gave a total sum of £33,187, from which it was proposed to pay the same dividends as for the previous six months. The amount to be carried forward would then be £20,418, which was an increase of £283. He was sure the proprietors would agree that the Company had had a most successful half year. It was also an additional pleasure to the Directors to be able to state that the pumping station at Tyttenhanger was now fitted with duplicate machinery; and the expenditure at this station was for the time being finished. Recently the Directors visited the whole of the pumping-stations of the Company; and they took the opportunity of inviting representatives of the various local authorities to accompany them—and more especially to witness the formal opening of the Tyttenhanger pumping-station. The Board believed that this visit would prove of benefit to the Company. It was the means of showing the authorities the ample provision that had been made to supply the growing district with water. On behalf of himself and the other Directors, he could assure the proprietors that the works were in excellent condition, and that an ample supply of both water and gas was being given. The outcome of the work that had been undertaken, which had been long and arduous, was seen in the excellent results that the Board were able to place before the shareholders that day. The Directors felt that the gratifying achievements of the past half year, as placed before the proprietors, were mainly due to the able services of their Engineer (Mr. F. J. Bancroft); and they were confident that the shareholders would join with them in congratulating Mr. Bancroft and his efficient staff on the continued progress of the Company.

Mr. ALFRED LASS, F.C.A., having formally seconded the motion for the adoption of the report and accounts,

Mr. PARDY said he had been taking out some figures on similar lines to those adopted by Mr. F. J. Bradfield, the Secretary of the Commercial Gas Company in his comparisons of the working results of the London and Suburban Gas Companies. One thing he found was that the residual products made a very good showing indeed. The Chairman had been speaking of the charges for distribution being more in the past half year than in the corresponding period of 1912; but if the outlay was reckoned per 1000 cubic feet sold, it would be seen that it had been less. There had, in fact, been a saving of over ½d. per 1000 feet; and this, taken on a sale of 92 million cubic feet, was worth having. He then proceeded to call attention to the receipts and expenditure on public lighting, and concluded by expressing gratification at the excellent nature of the report. The Board, he remarked, spent money freely, but they spent it wisely and well. He congratulated the Chairman and Directors and the Engineer on the results achieved.

The resolution was then put to the meeting, and carried unanimously.

On the proposition of the CHAIRMAN, seconded by Mr. LASS, dividends were thereafter declared, less income-tax, for the half year, at the rate per annum of 8½ per cent. on the "A" and "C" stocks, 7½ per cent. on the "B" stock, and £5 19s. per cent. on the "D" capital gas and water stocks.

Mr. A. F. PHILLIPS said he had much pleasure in proposing a vote of thanks to the staff for the efficient services rendered by them during the past half year. Probably Mr. Bancroft had not experienced as much anxiety in the past six months as he did in the previous half year, when he was running a race in the completion of the Tyttenhanger pumping-station with the increasing consumption of water in the district. They all knew that Mr. Bancroft had been victorious, and had greatly enhanced the value of the Company's property by ensuring to the consumers an adequate supply of water. They had also heard from the Chairman of the excellent results obtained from the gas-works—showing that both sides of the business received Mr. Bancroft's careful attention. To their worthy Secretary the shareholders would also feel grateful, as well as to the staff who, along with these two officers, were devoted to the interests of the Company.

Mr. W. B. BRYAN remarked that, as a considerable shareholder, he was delighted to second the proposal.

The vote having been heartily carried,

Mr. DREW and Mr. BANCROFT both acknowledged it. The latter, referring to the remarks that had been made by a shareholder about the public lighting, said that even had the figures been as quoted, he would not have had the slightest apology or excuse to make for them. Anyone connected with the management of a gas undertaking would know that the spending of money on the public lighting was of the very greatest advantage to an undertaking. Gas suppliers should do all they could to be on the very best terms with the local authorities. The only cloud on the horizon at the present time was the price of coal. This in the next half year would take £1000 more than usual—making a total of (say) £2000 for the year. This, of course, was a matter that was outside their control; but he and the staff would endeavour to neutralize it by achieving better results.

Mr. J. W. BUCKLEY, in proposing a vote of thanks to the Chairman and Directors, said that, having spent the greater part of his life in the administration and management of gas-works, it was a pleasure to be able to testify to the excellent results achieved at Barnet. They reflected the greatest credit both on the Board and on the staff. As to water, anyone going to Tyttenhanger would see a pumping-station that was second to none in the country.

The proposition was seconded by Mr. PLUMMER, carried unanimously, and briefly acknowledged by the CHAIRMAN.

MR. GOODENOUGH'S LECTURES ON GAS AS A FUEL.

Some Criticisms Answered.

The current issue of the "Journal of the Society of Arts" contains the following letters criticizing the Cantor Lectures delivered by Mr. F. W. Goodenough, the Controller of Sales of the Gaslight and Coke Company, before the Society early in the year, which have just been published.

I was present at both Mr. Goodenough's lectures on "Coal Gas;" but as the custom is to allow no discussion after Cantor Lectures, I was unable to put forward certain points which occurred to me in connection therewith. With your kind permission, I should like to mention them now.

Mr. Goodenough, in the early part of his first lecture, referred to "the crimson glow of a gas-fire." Now, I may be colour-blind or merely unfortunate, but I have never come across a gas-stove which gave a crimson glow. The colour is usually yellow, orange, or blue. The stoves exhibited and lit during the lecture only went to confirm my impression.

I should like to ask Mr. Goodenough what is the product of gas-fires which causes many people to suffer from neuralgic headaches if they spend longer than half-an-hour in a room where one is present. I suffer this way myself; and though the lecture room of the Society of Arts is large and lofty, both my wife and myself experienced bad headaches during the lecture, and were quite glad when the stoves were turned out.

Mr. Goodenough also referred to the quantity of soot deposited on the outside of London buildings, which, according to the experiments of the "Lancet" in the S.W. postal district, worked out roughly at 460 tons per square mile, or (say) 15 cwt. per acre per annum; that is to say, 4½ lbs. per acre per day. It is as well to remember that a good portion of this deposit is probably dust which has attached itself to the soot, and that the rate of deposit mentioned only amounts to 5 oz. per square yard during the year, and a very great deal of this gets washed down the sewers. The fumes from gas-stoves would appear not to remain guiltless of affecting our building stone.

For my own part, I prefer dirt outside my home to in it; and indoors I find gas as great an offender as any in regard to depositing dirt, especially where walls and ceilings are distempered and incandescent burners are used. The products of combustion in the gas seem to unite with some substance in the distemper and oxidize into an unpleasantly dirty surface. In the same way, picture-wire seems to suffer early decomposition and lose its strength.

In regard to fogs, a good reason for the reduction of these seems to be that the numerous pools of stagnant water and marsh which twenty years ago surrounded London have now been drained and built on, and therefore cease to affect the atmosphere. This is confirmed by the fact that when thick fog is met with in the outer suburbs, one finds only a thin fog on arrival in the central parts of London. While we remain liable to the weather we frequently get in London, we shall always be liable to fogs. An amusing incident in this connection occurred a few months ago. A long article appeared in an evening paper stating that 1½ million gas-stoves had taken the place of coal-fires and served to abolish fog. The very next morning one of the worst fogs we had had for ten years descended upon us.

Of course, the great majority of fire-grates of twenty years ago were as bad as could be, and in the old houses these have not given place to grates constructed on correct principles to the extent they should. Still the number of fresh grates put into houses newly erected in that period must run into millions, as each new house will account for (say) six to sixteen, though about one-half of them have no prospect of being employed for any other purpose than ventilating. If a gas-stove is inserted, they are even robbed of this function.

Mr. Goodenough rightly said that a badly constructed or choked chimney will remain bad in operation whether coal or gas be used. A good instance of this occurred when I first entered my present house. For six months I exhausted every means to get the fire to work satisfactorily enough to enable me to sit in the library. Finally I had the builder's man in to make a hole in the wall at the bend of the chimney, and he then removed no less than ten pails full of mortar, soot, loose brick, &c., the accumulation of ages. A gusty, squally day will have the effect of blowing both smoke or gas fumes into the room.

Mr. Goodenough cited the case of a carpenter whose child died of bronchitis because he had not a gas-stove. If he had had some doctors I know of, they would decline to treat a case of bronchial trouble at all if the patient employed a gas-stove. He also cited the case of a nursing home which abolished coal in favour of gas to their satisfaction, though he omits to mention whether the patients were equally pleased. He says the result was they were able to do with one servant the less. A nursing home would presumably require about twenty fires, and may have been able to make this saving. But I must own I remain very sceptical of this saving of one maid whenever I hear it mentioned, for the reason that for six months in the year domestic fires are not required at all. Presumably during those six months the said maid had duties to perform, and did not merely read novels in the kitchen. If she is got rid of, her fellow-maids will have to do that work instead; and with my knowledge of the modern domestic I imagine she would not relish being thus "put upon."

There is, of course, room for the gas-stove (we most of us have *one*). In a large number of cases, if one was not employed, a room would have to do without heat altogether. But to cry "Gas for Everything," and claim the result as always more healthful and economic, as many advertisements I have seen lately have done, is to overstate the case—a proceeding productive of more harm than good.

Mr. Goodenough read to us parts of the report of the Coal Smoke Abatement Society for 1906, and told us the means since taken to meet their suggestions. There are some parts, however, he did not read, as to which I should like some information. The report says: "All gas-stoves should be provided with an extra opening not less than 20 inches square when full open, to enable the room to be properly ventilated." Dr. Rohe's "Text-Book of Hygiene" says, "for every lighted gas-

burner, 12 to 15 cubic metres of fresh air per hour must be furnished in addition to the ordinary requirements, to keep the air of the room at the standard purity." Now this means roughly 330 to 400 cubic feet of air per burner; and if a gas-stove has sixteen burners it means that in an ordinary room of 2500 cubic feet capacity the extra air required for the room is equal to renewing the whole air of the room twice an hour. This is taking no notice of the air needed by the inmates of the room.

I have my own theory as to why gas-fires ventilate a room so much worse than coal-fires. It is that the coal-fire draws air from all parts of the room, but the gas-stove makes what I call a short-circuit to the nearest air supply, and continues to draw air from the same source, leaving the remaining air of the room unchanged.

Mr. Goodenough describes gas as purified coal; but many of the bye-products taken out in making gas seem to me very useful in assisting to generate pleasant heat, which may be why Mr. Darling has declared that the average primary heat generated by a gas-stove does not come within 100° Fahr. of that from a coal-fire. The heat from a gas-stove seems to find greater difficulty also in passing obstacles to distribute itself to the farthest parts of a room than is the case with coal-fires. As radiant heat is the important heat, it should be noted that Mr. Goodenough credits gas with 50 per cent., while the Coal Smoke Abatement Society credit coal-fires with 75 per cent. as available for heating a room and its occupants.

A year or two ago, the gas companies obtained permission to lower the quality of their gas. I should like to know what effect this had on the heating power of gas, and also on its likelihood to cause dirt or deleterious fumes.

From the ordinary householder's point of view, the Coal Smoke Abatement tests of 1906 are not very helpful, for the following reasons: The rooms used were large—about 4000 cubic feet, or about double the size of an ordinary room. They had just been erected, and the floors and walls consisted of simple brick with no plaster or woodwork; and the place had never been properly dried. Now, a brick is capable of absorbing a pint of water; and this fact would have considerable effect, for several hours at any rate, on the tests. Further, the rooms contained no furniture to obstruct and deflect the heat.

The gas-stove has undoubtedly improved on its early forefathers of ten years ago, and may be said to have reached the stage of the coal grate of 1890-1895, and cannot expect to equal the modern slow-combustion grate until it can provide greater ventilation for a room and emulate the inclined back of the modern coal-fire so as to throw its heat to a greater distance; but, of course, without throwing fumes as well. It will also have to be cheaper, as at present a coal-fire burns all day at the same cost as a gas-stove for three hours.

HYLTON B. DALE.

It is patent to anyone that Mr. Goodenough in his Cantor Lecture only shows one side of the question. Why does he not use comparisons, and put fairly before either his hearers or his readers both sides of a question of importance such as domestic heating? He grinds his own axe, and does not give fair comment on the only rival to gas of any value—anthracite coal, and the means at present in use for its consumption.

I should like to have the opinion of other members of the Society, and should be glad if you think fit to allow this letter to be printed for fair comment.

E. E. PITHER.

Mr. Goodenough, to whom proofs of the foregoing letters were sent, wrote in reply:

I am indebted to you for advance proofs of the letters from Mr. Pither and Mr. Hylton Dale criticizing my Cantor Lectures to the Society, and for the opportunity of replying to them.

Mr. Pither complains that I did "not give fair comment on the only rival to gas of any value—anthracite coal." My reply is that I referred to anthracite stoves in terms which, in my opinion, were considerably less unfavourable than I should have been justified in using. As he attaches no value to my opinion, I will content myself with quoting a far higher and a totally unbiased authority—that of Professor Leonard Hill, Professor of Physiology at the London Hospital, who (in conjunction with Mr. Francis Muecke, the Assistant-Surgeon at the London Throat Hospital) recently published [see "Lancet," May 10, 1913] the result of comparative experiments with anthracite stoves and gas-fires. Their pronouncement was as follows (the italics are mine):—

"In order to try and throw some light on the causation of infection with influenza and 'colds in the head,' which become rampant in the winter, and particularly under conditions of cold moist atmosphere, we have investigated the conditions which pertain to the mucous membrane of the nose and throat under various atmospheric conditions. Using a mirror and speculum, *we have found that the mucous membrane flushes and swells, becoming turgid with blood and tissue-lymph, and covered with a thick secretion, when the subjects are confined in a warm, moist atmosphere—e.g.*, 80° Fahr. At the same time the airway is narrowed and even choked up in those who have a deflected septum. *The mucous membrane of the nose and throat, just as the skin, is flushed with blood, and pours out secretion in order to cool the body.* After passing from the warm to a cold atmosphere, we find the mucous membrane quickly becomes paler, owing to constriction of the blood-vessels, but still remains swollen with tissue-lymph, as is shown by its appearance and by the fact that it pits deeply when touched with a probe.

"*The altered conditions seem to us to be such as may increase the liability to infection.* In a warm, crowded room, the swollen mucous membrane of the nose of an individual, covered as it is with thick secretion, will be massively infected with bacteria explosively sprayed out by the other occupants who sneeze, cough, and speak in the room. On passing out into the cold, misty ouside air, the blood-vessels constrict, and at the same time the nose is chilled by the greater conduction of heat due to the cold particles of water in the inspired air. The defensive mechanisms of the blood, the immunizing properties of the plasma, the cleansing action of the ciliated epithelium, and phagocytic action of the white corpuscles are diminished by the low temperature; while the pathogenic bacteria find a suitable nidus for their growth in the secretion and tissue-lymph of the swollen mucous membrane. The immunity to 'colds' of those who live an open-air life is well known. Massive infection does not occur; and so long as they are exposed to the cold outside air the mucous membrane, like the skin, remains pale and taut, moistened with a scanty secretion.

"Apart from the general question of health and immunity, *we believe it is the massive direct transmission of bacteria from one to another in warm confined atmospheres, and the subsequent exposure to the cold moist outer air, which together contribute to the infection of the susceptible individuals.* We can lessen our liability to such infection by keeping the air of our rooms and crowded meeting-places cool and moving. We find that a fan set to whirl the air in our experimental chamber will keep the nose paler and drier and the air-way patent, even when the air is heated to 100° Fahr. dry and 83° Fahr. wet bulb. Keeping the air in motion in crowded rooms by means of fans will not only keep the mucous membrane in better state, but also diminish the massiveness of the direct infection from mouth to mouth or nose to nose. We find that warm dry air flushes the mucous membrane with blood, but produces less swelling and secretion than warm, moist air does. *We find also that while convection heat—e.g., from an anthracite stove—flushes and swells the nasal mucous membrane, radiant heat—e.g., from a modern gas-fire—causes sweating from the skin, and does not affect the nose.* The cause of the headache and stuffiness felt in rooms heated by steam-pipes, stoves, and hot air is due, we believe, to the swelling of the mucous membrane of the nose and its air sinuses. *We find the change from convected heat to radiant heat relieves the stuffy feelings, and at the same time causes the skin to become moist and the nose to return to the normal 'out-of-door' appearance.*"

Passing to Mr. Hylton Dale's letter—which, taken in conjunction with the circular recently issued by the Society of Coal Merchants, of which he is the moving spirit, clearly indicates the serious inroads which gaseous fuel is making in the house-coal market—I can only express surprise that he should have taken so little trouble to ascertain the truth about his competitors. It is always a mistake to underrate your opponent, or to deceive yourself by refusing to face the truth.

Mr. Dale states that he suffers from headache in a room where a gas-fire is used, and instances the occasion of my lecture, when a number of gas-fires were lighted *and allowed to discharge all their products into the room.* For how long would Mr. Dale have cared to remain there if a similar number of coal-fires had been lighted in the lecture-room with no chimneys to carry off their products?

The testimony of independent research chemists, of hundreds of medical men who have been converted by experience from critics to admirers of gas for heating, and of tens of thousands of users of modern gas-fires, is available to prove that no injurious effects of any kind ensue from the use of a properly constructed gas-fire properly fixed and properly maintained. To quote against such testimony as that to which I have referred the views of some doctors of Mr. Dale's acquaintance who, through ignorance of what a good gas-fire is, would decline to treat a case of bronchial trouble if the patient employed a gas-stove, is simply to demonstrate the fact that to Mr. Dale the diminishing ignorance and dying prejudice of a few appear of more importance than the enlightened experience of the increasing many.

A few years ago, a considerable number of medical men held the opinion quoted by Mr. Dale; and it was not to be wondered at when one came to examine the sort of gas-fire upon which their opinion was founded. But the number of medical men in the district of the Gaslight and Coke Company known to be satisfied users of gas-fires, and who would endorse the opinion of a well-known family physician in London who always *urges* his bronchitis patients to use gas-fires—viz., that "everyone in any way delicate, *especially on the chest*, should have a gas-fire in the bedroom"—has increased in the past five years from 900 to over 3000. We have been steadily proving to them, by their personal experience, what the truth of the matter is.

Such points as Mr. Dale's quotation of Dr. Rohe's dictum in regard to gas-*burners*, as if it applied to gas-fires with a flue removing all products of combustion, his other attempts to confuse the issue by references to gas lighting, as if that were the subject under discussion, and his profession of disbelief in the saving of servants through the abolition of coal-fires in large households, of which I gave one of many actual instances within my personal knowledge, do not need comment.

There is one opinion in Mr. Dale's letter with which I am in hearty agreement, and I am glad to say that an increasing number of Londoners share the view—"I prefer dirt outside my home to in it." Hence these tears—on the faces of the Society of Coal Merchants!"

F. W. GOODENOUGH.

Public Lighting in London a Century Ago.—The following is from "The Times" of Aug. 27, 1813: "The avenues leading to the two Houses of Parliament, extending from Abingdon Street to the Speaker's house, are about to be lighted with gas. For this purpose, pipes have been laid down close to the side pavement."

Horley Gas Company.—There was a fair attendance of shareholders at the half-yearly meeting of this Company last Thursday. The Chairman (Mr. H. Webber) expressed regret that the year had not been a particularly prosperous one for the Company, who, like other similar companies, had suffered from the high price of coal. Another drawback was that their big customers had lowered their consumption each succeeding half year. They had a heavy less in this direction, but he was pleased to say they had continued to hold their own by the more extensive use of gas for illuminating and heating purposes by small consumers. As an illustration, for the month of August (though it did not deal with the present accounts) the amount taken from the meters showed an increase of 10 per cent. over the corresponding period of the previous year. The small consumers were, in fact, the sheet-anchor of the Company. It was on popularizing gas with their small consumers that their future success depended. They had excellent plant and works, and an efficient staff to deal with the increase when it came. He moved the adoption of the report, which recommended the payment of dividends at the rates of 5 and 3 per cent. on the respective stocks. Mr. James Randall, the Vice-Chairman, seconded the motion, and it was carried. The usual votes of thanks closed the meeting.

GAS SUPPLY IN HENDON AND SOUTHGATE.

The increase in the consumption of gas in the above-named suburbs of North London, which has of late years been a noteworthy feature of the operations of the two Companies responsible for the supply, is again evidenced by the reports presented at the recent half-yearly meetings of shareholders.

The report of the Directors of the North Middlesex Gas Company, which was submitted to the shareholders on Monday last week, was of a very satisfactory character. Compared with the first half of 1912, there was an increase of 12,604,600 cubic feet, or 10·28 per cent., in the quantity of gas sold in the six months ended the 30th of June; and there was a better return by £550 from residuals. The revenue from the sale of 135,132,800 cubic feet of gas for public and private use was £22,609; the rental of meters, stoves, and fittings produced £2546; and the total receipts amounted to £29,101. The following were the principal items of expenditure: Manufacture of gas, £13,440; distribution, £6124; rent, rates, and taxes, £1030; management, £1700. The total expenses being £23,522, there was a balance of £5579 to go to the profit and loss account. The amount available for distribution was £8674; and the Directors recommended the declaration of dividends at the rate of £5, £10 15s., and £7 10s. 6d. per cent. per annum on the preference, original, and additional capital respectively, and the carrying of £541 to the reserve fund. This appropriation amounted to £4390, and left a balance of £4284 to be carried forward.

At the meeting of the Southgate and District Gas Company last Thursday, the Directors reported that, compared with the results for the six months ended June 30, 1912, there was an increase of 10,125,100 cubic feet, or 10·79 per cent., in the quantity of gas sold in the past half year; while the returns from the sale of residuals were £767 higher. The sale of 103,933,700 cubic feet of gas for public and private use produced £17,465; and the rental of meters, stoves, and fittings, £1788. The total revenue was £23,253. The expenditure on the manufacture of gas was £10,844; on distribution, £4588; on management, £1397. The total expenses amounted to £18,749. The balance carried to the profit and loss account was £4504; and the amount available for distribution was £8478. The Directors recommended dividends at the rate of 5, 10, and 7 per cent. per annum, on the preference, original, and additional capital. This appropriation required £3687, and left £4791 to be carried forward. The Directors have lost two of their colleagues—Mr. John Earle Hodges having died on the 9th of February, and the Deputy-Chairman (Mr. John Allen) on the 3rd of May. Mr. Allen had been a Director for upwards of twenty-five years; while Mr. Hodges was elected a member of the Board as recently as 1908. The services of both gentlemen were highly valued. To fill the vacancies thus created, Mr. A. F. Phillips, M.Inst.C.E., and Mr. G. W. Carey have been appointed Directors.

COLLIERY OWNERS AND BYE-PRODUCTS.

[From a Nottingham Correspondent.]

Mr. J. T. Todd, the Manager of the well-known group of Blackwell Collieries, representing large ownership both in Nottinghamshire and Derbyshire, who previous to his association with mining work in this part of the Midlands held a position of a similarly important nature in the Newcastle district, has supplied within the last few days another significant illustration of the extent to which colliery proprietors are engaging in the manufacture of bye-products. The statement foreshadows a possible considerable development of such enterprise in many other quarters, for Mr. Todd, addressing the members of the Midland branch of the National Colliery Owners' Association, declared with characteristic directness that if colliery companies could not make more money out of selling coal, they must achieve the financial result desired by turning the coal into something else and selling it. Of the potentialities presented in this connection, interesting evidence was afforded by the new bye-product plant at the B Winning Colliery, the inspection of which on Wednesday last formed the special object of the members' assembly. The colliery has now a weekly output of about 1600 tons of sulphate of ammonia and ammoniacal liquor. Mr. Todd's experience, as a member of both the Nottinghamshire and Derbyshire Minimum Wages Boards, has apparently supplied ample material leading to the conclusion as to the impossibility of any adequate return upon the sale of coal itself, in face of the men's present inordinate demands; and as an example of how more profitable methods may be resorted to, the experience at the B Winning Colliery is distinctly instructive. But obviously there is a serious consideration involved, for if Midland colliery proprietors generally are to follow the lead here set, those responsible for the management of corporation and privately owned gas undertakings will necessarily be confronted with competition, the far-reaching effects of which it would be difficult to exaggerate.

It need scarcely be said that the scheme represented by the Blackwell Company's latest enterprise is by no means in the nature of a novelty, particularly as there is one other colliery at no great distance from it in this part of the Midlands which anticipated Mr. Todd in his venture. Yet, upon economic grounds, whatever may be the result of the latest undertaking in Derbyshire, there is apparently a larger contingent prospect of remunerative working through the exploitation of bye-products than would be directly derived from the sale of the lower grades of coal. The outcome of the Derbyshire experiment will be watched with interest in areas apart from the Peak County. The figures in regard to the anticipated output from Blackwell seem to suggest that the computation has been based upon a liberal scale.

Doncaster Gas Supply.—The accounts of the Doncaster Corporation for the year ended the 31st of March, which have just been issued, show that the gas undertaking is progressing by leaps and bounds, despite the keen competition from the Electricity Department. Receipts from gas have gone up from £42,000 to £46,000, and the profits are £6231, against £4866 in the previous year.

OSSETT GAS-WORKS EXTENSIONS.

Financial Aspect of the Scheme.

In the last number of the "Journal," it was stated that the Ossett Corporation had decided to spend £26,000 on the extension of the gas-works, and that the scheme, which has been prepared by the Gas Engineer and Manager (Mr. A. E. Mottram), includes an installation of vertical retorts on the Dessau system, the contract for which has been placed with Messrs. Leech, Goodall, and Co., of Leeds. The project is one of such importance, that a long article was recently devoted to it in a local paper. Three main questions presented themselves for consideration: (1) Why is this heavy expenditure necessary? (2) How is the money to be spent? (3) What effect is it likely to have on the future price of gas? Briefly stated, the answers given are: (1) The expenditure is necessary because the increasing consumption of gas is fast outstripping the productive capacity of the present works. (2) The money is to be spent, not only on a new retort-house, but in modernizing the whole works on a carefully-considered plan which will allow for the natural expansion of the future. (3) So far from the expenditure being a millstone round the neck of the works, by producing gas more cheaply than is possible with the present antiquated plant the prospects of gas at a lower price should be increased.

The writer first of all shows that the present works are becoming inadequate. The maximum output of gas is, in round figures, 5 million cubic feet per week; and last winter the weekly make was 4,350,000 cubic feet. This left but little margin for increase. Faced with this serious difficulty, the Corporation appointed a Sub-Committee to consider the matter. They visited various gas-works, and, as already mentioned, reported in favour of the Dessau system of carbonization, which is fully explained by the aid of a diagram showing a section of a retort-house. Coming to the financial results expected to accrue from the extension, the writer offers the following remarks.

Not only are the new retorts and machinery expected to do for 9d. per ton that which is costing 2s. 9d., but also to give vastly better results in gas produced, and at least equal results in residuals. The Sub-Committee, on the basis of information obtained of actual working results of Dessau retorts at Sunderland, East Hull, and Birmingham, and the guarantee given by the makers, calculate upon producing per ton of coal 14,000 cubic feet of gas of about the same quality as is now supplied. The present retorts make 11,300 cubic feet per ton.

The makers of the plant guarantee a minimum of 12,500 cubic feet of gas per ton of coal. Beyond this, the make may be augmented by the introduction of a kind of water gas. If the make of coal gas is no more than the makers' guarantee, and a total of 14,000 cubic feet per ton is produced, as estimated, it means that the final gas will be a mixture of coal gas and water gas, in the proportion, roughly, of about eight to one.

According to these calculations, the cost of handling the coal is going to be reduced by 2s. a ton, and more gas is to be produced to the value, at 2s. 6d. per 1000 cubic feet (the average price received), of 6s. 9d. per ton. Stated in another way, in order to make the 158 million cubic feet which will be wanted next year, the present plant would require 14,000 tons of coal; and the cost of carbonizing it, at 2s. 9d. per ton, would be £1864. Taking £8400 as the cost of the coal, the total is £10,264. With vertical retorts, to produce the same quantity of gas, only 11,300 tons of coal would be required, costing £6780; and the cost of carbonization, at 9d. per ton, would be £423—making a total of £7203. As less coal would be used, there would necessarily be less coke, tar, and liquor to sell—producing £6367, against £7861. But allowing this difference, the calculation gives a balance of £1567 in favour of vertical retorts. To this must be added the saving in cartage which the railway siding will effect; the coal being brought on to the works by rail instead of by carts. This is estimated at £376; and without taking into account the profit on the increase in the sale of gas which will take place before the new works are erected—this is expected to occupy a year—the calculations of the Sub-Committee are that such economies will be effected as will leave a surplus, even after the yearly capital charges, in the shape of interest and sinking fund on the £26,000, are paid. As the consumption further increases, so should the economies. If their forecast of the results is even approximately correct, the prospects of a cheaper gas supply should be enhanced.

CO-OPERATION AND INDUSTRIAL STRIFE.

The Ninth Congress of the International Co-Operative Alliance was opened in Glasgow on Monday last week, under the presidency of Mr. William Maxwell. Among those present was Earl Grey, the Honorary President of the Alliance, who delivered the Inaugural Address. He sketched the growth of the co-operative movement, and explained the essential principles which are common to co-operators all over the world, and then spoke as follows on the subject of

Co-Operation and Industrial Strife.

The benefits which co-operation has it in its power to confer upon our industrial communities are not only material in their character. The moral advantages which flow from the successful application of the co-operative principle to our industrial and social life are not less conspicuous or important. I do not wish to descant upon the deplorable antagonism which, unfortunately, most undoubtedly exists between capital and labour. Suffice it to say that our present industrial organization is responsible for much selfishness, suspicion, and hatred, and consequent inefficiency, with its resultant sequel of poverty and discontent. The wants of society can never be adequately met so long as the twin forces of capital and labour are warring against each other, within the bosom of a single State. Co-operation shows how the warring forces of capital and labour can be reconciled with advantages to all concerned, the value of which it is impossible to over-estimate. It remains for all who have at heart the well-being of their fellow-men to promote, as far as they can, the transition from present conditions

to a social state in which the spirit of fraternal co-operation shall prevail. It was the dream of Mazzini—perhaps the most inspired prophet of the last century—that the day would come when, not by any State action, but by the voluntary association of free men, the hireling of the capitalist should become his partner, sharing with him the net profits of the industry which they were jointly serving, one by the loan of his capital, the other by the gift of his labour.

Without raising the question of whether or not the idea of co-partnership, which animated Vansittart Neale and his pupils in their endeavours to establish the Alliance, is expedient, I cannot help thinking that it will in the future find a more important place among the foremost ideas of our reformers than is the case to-day. In my confidence that in all free communities truth will ultimately prevail, I gladly leave that question to be settled by the ordinary processes of free and honest and disinterested discussion. I only wish to say that, in whatever direction the co-operative spirit may lead in the future, we have good reason to be satisfied with the advance that has been made during the time which has elapsed since the foundation-stone of the Alliance was laid eighteen years ago.

PATENT FUEL INDUSTRY AND DISEASE.

Dangers of Tar and Pitch.

It may be remembered that about two years ago, Mr. Alfred H. Lush, Barrister-at-Law, made a report on an inquiry held by him, by direction of the Home Secretary, into the draft regulations proposed to be made for the manufacture of patent fuel (briquettes) with the addition of pitch. The following were among the principal conclusions and recommendations of the report: The patent fuel industry was not, on the whole, an unhealthy one, and the use of the manufactured article involved no risk to health. There were, however, certain eye troubles among the workers, owing to fragments of pitch striking the eyes or pitch-dust getting into the eyes, and also certain skin troubles. Nearly all fuel workers experienced a burning sensation in the face and extreme sensitiveness to the action of sun or wind after exposure to pitch dust. After some years of working, there was a tendency for a peculiar kind of warts, known as pitch warts, to form on the face and body, and a large proportion of the men who had been long exposed to the pitch dust were affected by them. The warts were not usually malignant; but when they occurred in particular situations there was a distinct liability to a certain form of cancer. Neither the mode in which dust operates to produce cancer nor the particular ingredient in the dust which is at fault had then been ascertained. The remedies proposed in the draft regulations were the prevention of dust in the factories by the encasing of disintegrating machines and elevators carrying the mixture of coal and pitch, the provision at the works of baths and lavatory basins and their compulsory use by the men, and the provision of overalls and goggles which the men were to be compelled to wear. The report recommended that time should be allowed for experiments to be made to determine the various questions then unsettled; and that the inquiry should be adjourned for the purpose. The inquiry was resumed in March last, and Mr. Lush's second report, dealing with it, has lately been issued. A circular was issued in November, 1911, setting forth the conditions of the adjournment, and a great part of the evidence given at the inquiry related to the action taken by the employers in response to the circular, and to the results of their action. Mr. Lush says he is satisfied that they have endeavoured to carry out fairly and honourably the conditions as they understood them. He deals with them in order.

Considerable experience with baths and wash-basins has been obtained at Cardiff and Swansea; but the results have differed curiously as between the two towns. At Cardiff, six men selected by the management took the baths regularly from their completion, and they were all agreed that the effect of bathing at the works and then going out into the open air was to produce very severe pain in the face and in the eyes, and that these pains were much worse than those they experienced when they used to go home "black" and wash afterwards. They also complained that they were more liable to colds and rheumatism. At Swansea, no experience of value was gained as to baths; but a great deal as to the effect of washing the face and upper part of the body at the basins. None of the men complained of any increase of pain. In accounting for the difference of experience between Cardiff and Swansea, Mr. Lush says a good deal must be allowed for the strong prejudice against the baths which has all along existed among the Cardiff workers; and no doubt there was much exaggeration in their evidence. Mr. Lush is of opinion that there has been a real improvement in the health of the men, especially at Swansea.

Reference is made to the researches of Drs. Ross and Cropper on the origin of cancer; and since the early part of 1910 they have directed their attention to the special problem of the pitch workers. They have conducted a number of experiments, and have put forward a theory which they have set forth at length in articles and pamphlets they have published, and in Dr. Ross's evidence at the inquiry. Mr. Lush shortly states the theory, and then deals with the experiments on which it is based. Among the substances treated were a number of samples of coal and of coal products, such as tar, pitch, and the oils given off in the distillation of tar. Care was taken to avoid the possibility of unconscious bias by dealing with samples which were distinguished by letters of the alphabet only, and the key to these letters was retained, until after the experiments, by Mr. W. J. A. Butterfield, M.A., F.I.C., the Secretary to the Metropolitan Gas Referees, by whose aid the samples were mainly obtained. The more important results arrived at may be shortly stated as follows: Pitch obtained from gas-works tar is mischievous, but not that from the tar of blast-furnaces. This result is in exact accordance with Dr. Legge's observation that blast-furnace pitch can be used without any appreciable risk of the pitch warts and pitch cancer which arise from the use of gas-works pitch. If the distillation of gas-works tar is carried to a temperature of 360° C., the resulting pitch is no longer mischievous. Pure anthracene oil is not mischievous; but the commercial rough anthracene cake is so. The bituminous coal from which gas-works pitch is obtained contains agents of the same mischievous character as those of the pitch; but these are rarely found in the Scotch splint coal, which is the main source of supply for blast-furnace pitch.

Mr. Lush says it is outside his province, and beyond his capacity, to determine whether or not the general theory of Dr. Ross and his colleague is a sound one. But so far as concerns the special subjects of the inquiry, he feels justified in saying that the results of the experiments made in pursuance of that theory are in close agreement with the observed effects on the health of the pitch workers, and that in "The Problem of the Gas-Works Pitch Industries and Cancer" they appear to have afforded an adequate explanation of the manner in which pitch dust operates to produce pitch warts. Everything points to the conclusion that pitch cancer is dependent upon the prior existence of warts; and if these can be prevented the problem of the pitch worker's cancer would seem, for practical purposes, to be solved.

Mr. Lush considers that the great importance of the work of Drs. Ross and Cropper, in its bearing upon the inquiry, is that it points to the possibility of striking at the source of the evil by eliminating from the pitch the ingredients that give rise to the mischief. Even before the opening of the inquiry in 1911, Dr. Ross and his colleague had begun to experiment in this direction. The first method to be tried was washing the pitch; and this method was perfectly successful for its immediate purpose. But, unfortunately, the pitch so treated proved to be unsuitable for the manufacture of briquettes. Next the tar itself was washed before distillation; but this course was found to be objectionable from the point of view of the tar distillers. It has already been mentioned that if distillation be carried to a temperature of 360° C., the pitch that is left should, according to the experiments, be harmless; but the method thus indicated is open to the objection that this pitch would be too dry for use in briquettes. Mr. Hilditch has since suggested that the defect might be remedied by subsequently restoring some of the middle oils to the pitch. Minor suggestions made by Dr. Ross for reducing the risk of disease, pending a complete solution of the problem of eliminating it altogether, include the carrying of distillation to the highest point of temperature that will leave pitch of a serviceable quality, and the mixing of a proportion of less bituminous coals in the production of the tar. A quite different method has just recently been tried by a West Bromwich firm of tar distillers—viz., the addition to the tar, before distillation, of a small quantity of formaldehyde. In Mr. Lush's former report, he expressed the opinion that the elimination of the mischievous agent from the pitch would afford a more satisfactory solution of the difficulty than could possibly be attained by the draft regulations; and now that such a solution seems to be within grasp, he is still of this opinion.

The position at the close of the inquiry was this: The manufacturers had done a great deal to reduce the dust evil and in other ways to improve the health conditions of the workers, and they were obviously willing to do anything further that was reasonably required. Compulsion on the men had been shown to be impracticable, because the workers are unwilling to submit to it; and it cannot be said that their objections are altogether unreasonable. It has not yet been proved that the taking of baths is a complete prevention of the evil, and there is reason to doubt whether taking them at the works is suitable for all workmen under all circumstances. In the absence of such compulsion, it would be useless and unjust to ask the employers to incur expense on the scale contemplated by the draft regulations. The wider knowledge made available by the inquiry had led to the conclusion that the proposals of the regulations for preventing dust in the factories were not fully adequate for the purpose. Lastly, there was the prospect that a commercially practicable method of eliminating the mischievous agent may shortly be available, and the whole scheme of the regulations thus rendered obsolete. Mr. Lush consequently has no hesitation in recommending their withdrawal. He points out, however, that they have already to a large extent effected their purpose; and he says Dr. Legge and the Factory Department may be congratulated upon having, by their labours, brought about great improvements in the health conditions of the fuel workers, with every prospect of still further improvements.

Vertical Retorts for Bangor (Co. Down).—The Belfast Banking Company, Limited, have agreed to grant a loan of £11,000 to the Bangor Urban District Council, under sanction of the Local Government Board for Ireland, for the purposes of the proposed installation of vertical retorts at the gas-works.

Automatic Public Lighting at Ashton-in-Makerfield.—At a recent meeting of the Ashton-in-Makerfield Urban District Council, the Gas Manager asked their consideration of the advisability of adopting on a small scale a system of automatic lighting of public lamps. As it was proposed to erect a number of additional lamps, he considered this a favourable opportunity to instal automatic appliances without disturbing existing labour conditions. The cost would be about 30s. per lamp, while the saving per annum would amount to 10s. for labour, 2s. for gas (later lighting), and if extinguished from 12.30 to 3.30 a.m. 10s. 10d. —a total of £1 2s. 10d. The Committee approved the provision of automatic controllers as recommended.

Oil v. Coal.—In a letter which appeared in "The Times" last week, Mr. Walter Hunter, the Deputy-Chairman of the Commercial Gas Company, offered the following remarks on the subject of the use of oil instead of coal for naval purposes: "There is one point in regard to this interesting question which, so far as I am aware, has hitherto escaped attention, or has been kept in the background. Our store of coal is one of our most valuable assets; and coal can always be bought at the market price when required for use. Until it is so bought, its cost forms no part of our annual expenditure. On the other hand, the main supplies of oil come, and must in future come, from foreign countries. Every gallon of oil, beyond the comparatively small quantity to be obtained from native shales, must be paid for before it reaches our shores; and the tanks or other receptacles for storing it must entail large expenditure. It is evident, therefore, that the establishment of stores of oil large enough to meet the requirements of a naval war must involve heavy capital outlay, resulting in proportionately heavy revenue charges. As these charges do not arise, except to a limited extent, in regard to the storage of coal, it seems to me that this side of the question requires careful consideration."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Bonnyrigg.—The "A. & M." automatic lighting system has been fitted to the 120 public lamps in Bonnyrigg. The matter has been discussed for several years, but has only now been completed.

Dundee.—The make of gas in Dundee has grown in the last twelve years by 62 per cent., though the number of retorts has only been increased to the extent of 21 per cent. This increase, of course, only refers to Dundee proper, and takes no account of the added area, recently acquired, which will add about 8 per cent. further to the quantity of gas required. Mr. Alexander Yuill, the Engineer, stated, at a meeting of the Gas Committee of the Town Council on Thursday, that he advocated that the installation should be on the vertical-retort system; and the conditions he claimed for this system were an increased yield of gas per ton of coal, an improved quality of coke, the nuisance from smoke, dust, flame, and steam would be practically eliminated, and naphthalene trouble would vanish. He claimed that vertical retorts had now passed out of what he might term their experimental stage. A further advantage of the vertical retort was the fact that the space for a given capacity was much less than would be required for any other form of gas-producing plant. The new scheme provides for a production of 2½ million cubic feet per twenty-four hours. The anticipated cost would be from £32,000 to £35,000, according to which of the four different designs on the market is chosen; but it is reckoned that this expenditure will be more than compensated for by the saving seffected. The Committee decided that such an installation should be arranged for, and instructed the Engineer to obtain offers from the different makers of these plants.

Dunfermline.—The District Committee have approached the Town Council with a view to ascertaining the terms upon which they would supply gas for public lighting. This is the result of petitions frem ratepayers in the district lying between Torryburn and Valleyfield. The matter has been placed in the hands of the Public Health Committee and the Finance Committee, so as to get it pressed forward; and, if the price to be charged proves satisfactory, the lighting districts will be formed so as to take advantage of the lighting in the coming winter.

Falkirk.—A curious explosion has occurred in the Carronshore district. The street-lamps are extinguished during the summer months; and when lighted for the first time the light caused an explosion in the base of the lamp-column, where there had evidently accumulated an explosive mixture. A boy named Robert Kay, who was playing with some other lads in the vicinity, was burned about the face and hands. Fortunately his injuries are not of a serious character, though severe.

Holytown.—The Gas Company held their annual general meeting at their rooms on Wednesday, when Mr. George Russell, senior, of Townhead, the Chairman, presided. The report and the statement of accounts were presented, which contained the following recommendations: That a dividend of 10 per cent. be paid for the year; £25 added to the reserve fund; £75 3s. 10d. allowed for depreciation; and £50 carried forward. These were agreed to; and the three retiring Directors, Messrs. James Brydon, Robert Robb, and John Whiteside, unanimously re-elected, as was also Mr. William Waddell, C.A., Glasgow, the retiring Auditor. At a subsequent meeting of the Directors, Mr. G. Russell, senior, was re-elected Chairman: Mr. Thos. Forbes, Vice-Chairman; Mr. William Darling, Secretary; and Mr. G. Russell, junior, Treasurer. The price of gas was reduced by 5d. per 1000 cubic feet—making it 2s. 6d. for motive power, 3s. 4d. for ordinary, and 3s. 10d. for slot meters.

Kilwinning.—Judge Smith performed the opening ceremony of the extensions which have been made at the gas-works, consisting of a new purifying plant, at a cost of about £1000. This has been rendered necessary on account of the greatly increased gas consumption required by the town. Judge Smith, at the conclusion of the formal opening, was presented by the Contractors with a handsome case of cutlery.

Kirkcudbright.—The Gas Committee reported to the Town Council that for the year to May 15, 1913, the total income was £1565 15s. 9d., against an expenditure of £1471 3s. 3d., which leaves a balance of £94 12s. 6d. A number of improvements in the street lighting have been suggested by the Manager to the Streets Committee, and the purchase of 12 new second-class lamps recommended; but cheaper proposals asked for certain other positions.

Larkhall.—The local Lighting Committee are having the Horstmann patent clockwork automatic lighter and extinguisher fitted to the public lamps throughout the district.

Slamannan.—The gas-works, which recently changed hands, are to supply light for the street-lamps, and the hope is expressed locally that the incandescent burner will be installed by the Lighting Committee of the district; the lamps at present being fitted with flat-flame burners, which only give a very poor light.

Skye.—The finding of oil shale in the Island of Skye, by a member of the staff of the Geological Survey of Scotland, may lead to some reduction in the price of oil required for carburetted water gas. The sample tested did not give good results, but they were badly weathered, being taken from the outcrops. No doubt the shale farther into the hillside will prove more rich in oil, and the manufacture of the various qualities be carried out at an early date.

New Capital for the Bognor Gas Company.—It was announced at the half-yearly meeting of the Bognor Gas Company (at which a dividend was declared at the full statutory rate) that work in connection with the electric light was in an advanced state, and the scheme promised to prove a great success. At a subsequent extraordinary meeting, a resolution was passed authorizing the Directors to issue a further £15,000 of capital, which is required chiefly for the electricity branch of the business.

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CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Aug.* 30.

Sulphate of Ammonia.

Throughout the week the market for this material has continued very firm, and a further improvement in prices has to be recorded. Not only have middlemen shown themselves desirous of securing those parcels which have been offered by tender, but there has also been a fair amount of inquiry from foreign consumers. The nearest values at the close are £13 6s. 3d. per ton f.o.b. Hull, £13 7s. 6d. per ton f.o.b. Liverpool, and £13 8s. 9d. per ton f.o.b. Leith. Few producers are now inclined to make sales in the forward position, preferring to await developments before disposing of a further portion of their output; but £13 12s. 6d. per ton f.o.b. Leith is reported to have been accepted for delivery in equal monthly quantities January-June, 1914.

Nitrate of Soda.

The price of this article is again dearer, and holders now require 10s. 9d. per cwt. for ordinary and 11s. for refined quality, on spot.

LONDON, *Sept.* 1.

Tar Products.

The markets for tar products remain fairly firm, but new contracts are difficult to arrange. Pitch maintains its price, and makers are very firm in their idea of value. On the other hand, Continental consumers do not show any eagerness to pay the present prices. However, several sales have been made during the week at very good figures. Benzol, 90 per cent., is firm, and there appears to be an increase in the consumption for petrol purposes; but for the forward position, buyers will not contract at the present prices. Solvent naphtha is quiet, and there are practically no inquiries in the market. Although prices are reasonable, consumers show no inclination to do business for the forward position. Heavy naphthas are also quiet, and transactions are reported at low figures. Creosote is firm, especially in London, where good prices have been paid both for prompt and for the forward position. Crude carbolic is dull, with no business doing either for the prompt or forward position.

The average values during the week were: Tar, 29s. 3d. to 33s. 3d. Pitch, London, 44s. to 45s.; east coast, 44s. 6d. to 45s.; west coast, Manchester, 43s. to 43s. 6d.; Liverpool, 44s. to 44s. 6d.; Clyde, 44s. 6d. to 45s. Benzol, 90 per cent., naked, London, 1s. 1d. to 1s. 1½d.; North, 11½d. to 1s.; 50-90 per cent., naked, London, 1s. to 1s. 0½d.; North, 11d. to 11¼d. Toluol, naked, London, 10⅜d. to 11d.; North, 11⅛d. to 11⅜d. Crude naphtha, in bulk, London, 5¼d. to 5½d.; North, 5d. to 5¼d. Solvent naphtha, naked, London, 10¼d. to 10⅜d.; North, 9¼d. to 9⅜d. f.o.b. Heavy naphtha, naked, London, 10d. to 10½d. f.o.b.; North, 9d. to 9¼d. f.o.b. Creosote, in bulk, London, 3⅜d. to 3½d.; North, 2⅜d. to 3d. Heavy oils, in bulk, London, 3⅜d. to 3⅝d. Carbolic acid, casks included, 60 per cent., prompt, east coast, 1s. 3d. to 1s. 4d.; west coast, 1s. 2½d. to 1s. 3½d. Naphthalene, £4 10s. to £9 10s.; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been a slight improvement during the past week, and prices have increased at all ports; but most of the business appears to be speculative, as the large consumers abroad will not pay the present figures. Outside London makes are quoted to-day at £12 10s.; Hull, £13 1s. 3d. to £13s. 2s. 6d.; Leith, £13 3s. 9d. to £13 5s.; Liverpool, £13 3s. 9d.; Middlesbrough, £13 2s. 6d. to £13 3s. 9d.

Manchester District Tar Prices.

It is officially announced that the average price realized for July deliveries of tar in the Manchester district—based on the value of the products—was 34s. 1d. per ton.

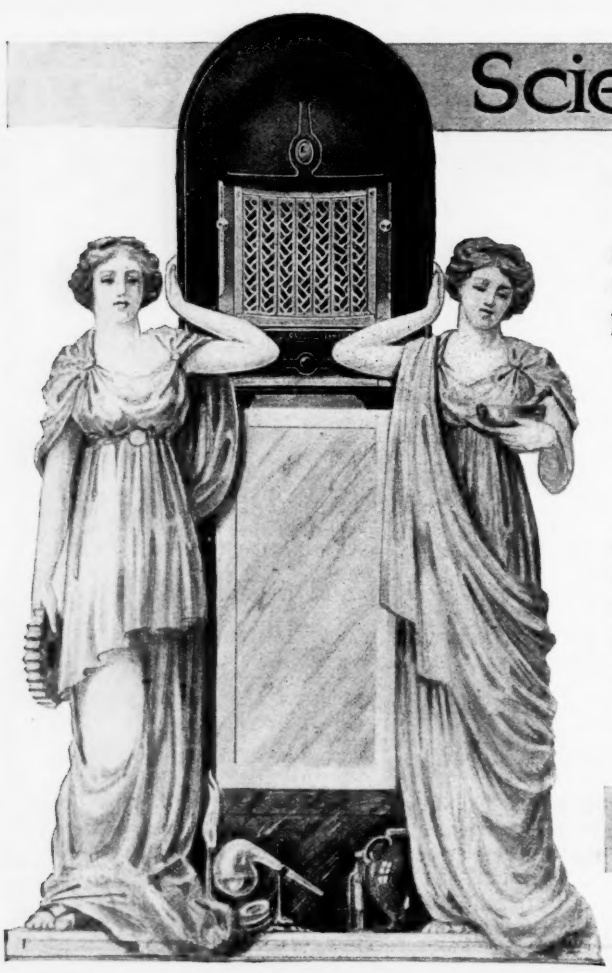
COAL TRADE REPORTS.

Northern Coal Trade.

In the Northern coal trade, there is a strong demand for prompt delivery, and prices are firm; but for forward delivery, quotations now show a slight ease for some classes of coal. In the steam coal trade, best Northumbrians are about 15s. per ton f.o.b. for early delivery; and for delivery towards the end of September 14s. 9d. is quoted. Second-class steams are 13s. per ton f.o.b.; and steam smalls are 8s. to 9s. 6d. The production is now a little fuller, and is well taken up; In the gas coal trade, there is a strong demand for early delivery, and best Durhams are from 15s. to 15s. 1½d. per ton f.o.b. Second-class gas coals are about 14s per ton; and "Wear specials," 15s. 6d. There is now a larger consumption of gas coals, and it should increase more rapidly soon. As to coal contracts, that for Stavanger, for some 10,000 tons, is settled at about 20s. per ton, delivered over twelve months. Tenders for about 20,000 tons of Durham gas coals for Gothenburg are believed to be under consideration, as well as one or two smaller lots for Northern towns; and there is still a demand for cargoes of gas coals for some of the Mediterranean ports. The demand for gas coal improves; but prices for contracts forward may be said to be easier. Coke is steady. Gas coke is in rather heavier export, with quotations from about 16s. 9d. to 17s. 6d. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

The demand for all qualities in the Scotch coal market continues strong, and prices are firm with an upward tendency. On Friday, the following were the prices quoted on the Glasgow Coal Exchange: Ell coal, best qualities, 13s.; splint, 12s. 6d. to 15s. 6d.; navigations, 15s. to 16s. 9d.; steams, 11s. 9d. to 13s.; Hartleys, 14s. 9d.; trebles, 13s. 6d.; doubles, 12s. 6d.; singles, 11s.; pearls, 10s.; dross, 8s.—f.o.b. Glasgow.



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DAVIS Gas Stove Co. Ltd.

High-Pressure Gas Lighting in Belfast.

The new high-pressure gas lighting experiment in Belfast has given so much satisfaction that an early extension of the system is expected. There are nine lamps in Donegall Place, one of the leading thoroughfares. These replace 19 lamps of smaller illuminating power. Each lamp has triple incandescent burners, each of 4500-candle power; thus giving to the street an illumination of 40,500-candle power, costing £50 per annum, as against £162 15s. for the smaller lamps. The "Northern Whig," referring to the installation, says that the brilliant effect of these high-pressure lamps "rebukes even the Junction"—another leading spot in the city's centre, the meeting place of several tram lines—"with its [electric] arc lamps." We learn that it is in contemplation to apply the high-pressure system to Royal Avenue and York Street—two great across-town thoroughfares, so that in a short time there will be a grand avenue of this class of lamp for about a mile-and-a-half in a straight line from the City Hall to the Midland Railway (Northern Counties) Terminus. The high-pressure lamps are, as readers may remember, used all round the City Hall area, though the lamps are smaller than those in Donegall Place.

Skegness Gas Supply.

Our local correspondent writes: A sharp fight is threatened regarding the proposal of the Skegness Urban District Council to apply for parliamentary powers to enable them to supply gas. The Council now stand committed to the scheme under which they intend to seek statutory authority, not only to control the supply throughout the town area and in the adjoining parishes of Winthorpe and Croft, but to acquire the undertaking of the existing Company and further to supply electricity, where needed, throughout the same locality. Preliminary grumblings which led to the split between the Council and the Gas Company were, however, sufficiently loud and deep to warrant the anticipation that it may not prove such an easy task as many appear to have imagined to dispose of the Company on other than very substantial terms. The case is one somewhat apart from the general order, in that the Company claim to have only within a comparatively recent period reaped anything commensurate with their investment, and this after years of waiting. During the last decade, Skegness has advanced by leaps and bounds; and now that the possibilities of a long looked-for increment are presented, the Company appear scarcely likely to acquiesce in terms other than those which will compensate for a period of inordinate waiting.

During the whole of the present month, the Windsor Electric Light and Gas Companies are each to have a number of special lamps in the streets, so that in March next, when the existing public lighting contract expires, the residents may form their own conclusions as to which kind of lighting to adopt.

Barnsley Gas Company.

Presiding at the annual general meeting of this Company last Thursday, Mr. E. G. Lancaster, in moving the adoption of the report and accounts, remarked that the position of the undertaking was rather more favourable than it was a year ago. Then the profits, which amounted to £7165, were not enough to pay the full dividends without having recourse to the carry-over; but this year they were £8217—an amount sufficient to pay the full dividend and leave £307 for the next account. The production of gas, its distribution, and maintenance charges cost £100 less than twelve months ago; while the other side of the account was equally satisfactory. The Company had sold £70 worth of gas less, compared with the previous year; but they had reduced the price by 2d. per 1000 cubic feet, which meant a saving of £1250 to the consumers. The residual products showed up equally well; coke giving an increase of £733, tar of £443, and liquor of £337.—a total of £1513. The gas sold amounted to 2½ million cubic feet more than before, notwithstanding that they had lost three big consumers in the borough lighting supply, the workhouse, and the township of Cudworth. This meant a total loss of 20½ millions. But it had only been felt to the extent of 9⅓ millions, as some of the contracts had not expired. The current year would have to bear the full brunt of the 20½ millions loss; but, considering they had increased the supply by 12 millions last year, it was reasonable to expect they would further nullify the loss this year. Their Manager (Mr. H. Hutchinson) was sanguine enough to predict that they would more than make up the remaining 8 millions; but he preferred to "wait and see." He was pleased to say that the number of consumers had increased by 783. They were mostly small ones, and they looked to the number continuing to increase steadily as people realized more the advantages of gas for cooking. One important fact in this connection must not be lost sight of—that while the price of house coal was steadily increasing the cost of gas was decreasing. This in time must tell its own tale, when people found they could get the same advantages and comforts with gas at less expense than with coal; and the Company looked forward to its resulting in a legitimate expansion of business. Referring to the cost of fuel, the Chairman said it would undoubtedly be dearer. They had made contracts for about two-thirds of their requirements, and had had to pay more. The report and accounts were adopted.

New Water Scheme for Honiton.—At a special meeting of the Honiton Town Council last Thursday, the Council in Committee recommended the adoption of certain portions of a recent report by Mr. Baldwin Latham, which dealt with the improvement of the filter-beds at St. Cyres at a cost of £700, and the increase of the pressure and the more satisfactory distribution of the water at a cost of £1960; the total outlay being £2660. It was considered by some members that the existing need could be met in a less expensive manner than that proposed; but in the end the recommendation was carried with only two dissentients.

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Increased Discount at Hartlepool.

The Directors of the Hartlepool Gas and Water Company, in the report adopted at the annual meeting last week, stated that the gross revenue for the twelve months amounted to £98,720. A dividend was declared at the rate of 5 per cent. per annum, less income-tax. The Chairman (Mr. O. K. Trechmann) pointed out that the profit was sufficient to allow of the payment of the maximum dividend, and leave a balance of £1600 to carry forward. The supplies of gas and water for both domestic and commercial purposes were more than equal to all demands. The use of gas, especially for cooking, heating, and industrial purposes, continued to increase, notwithstanding the keen electrical competition. The results of the past year had been so encouraging that the Board had decided to offer a further concession in the shape of increased discount to those consumers who paid their accounts when due. Hitherto they had been allowed a discount of 5 per cent., or about 1½d. per 1000 cubic feet, for prompt payment; but now the discount would be 2d., which would make the net cost of gas 2s. per 1000 cubic feet—a price that compared favourably with other towns in the district. Some time ago, the Directors decided to proceed with the installation of high-pressure gas. This work was proceeding satisfactorily; and the light would, it was expected, be ready for use by the beginning of October.

Romford Gas Company, Limited.—The accounts of this Company for the six months ended the 30th of June, which were presented at the recent half-yearly meeting, showed a balance of £3657 carried to the profit and loss account. The amount available for distribution was £7820; and the Directors recommended the payment of dividends for the half year at the rates of 13½ and 10½ per cent. per annum on the ordinary and "B" shares respectively, both less income-tax. These dividends amounted to £2884; leaving £4936 to be carried forward. There was 9·09 per cent. increase in the quantity of gas sold in the past half year in comparison with the corresponding period of 1912.

Bishop's Stortford, Harlow, and Epping Gas and Electricity Company.—At the half-yearly general meeting of this Company last Wednesday, the Directors reported an increase of 3,356,200 cubic feet, or 6·5 per cent., in the quantity of gas sold in the six months ended the 30th of June, compared with the first half of 1912. The balance to the credit of the revenue account was £3277. After charging £684 for interest and income-tax, £2593 was added to the profit and loss account, making the balance available for distribution (including £1110 brought forward) £3703. The Directors recommended the declaration of dividends for the half year at the full statutory rates per annum—viz., on the "A" ordinary stock, of £5 14s. per cent.; on the "B" ordinary stock, of £5 10s. per cent.; on the "C" preference stock, of £5 per cent.; and on the "D" preference stock, of £4 per cent. These payments absorbed £3089, and left a balance of £614 to the credit of the profit and loss account.

Eastbourne Gas Company.

The report adopted at the recent meeting of the Eastbourne Gas Company stated that the revenue account showed a profit for the half year to June 30 of £8778. After paying the February dividend, and other charges, there was a balance of £21,111 at the credit of profit and loss account; and dividends were recommended for the half year at the rates per annum of 7⅞ per cent. upon the "A" stock, 6¼ per cent. upon the "B" stock, and 5 per cent. upon the preference stock. These distributions would absorb £8785, and leave £12,326 to be carried forward. The Chairman (Dr. G. A. Jeffery) said they had had to face a very dear coal and oil bill; but by foresight, forethought, and strict economy they had managed to earn full dividends. There was some falling off in the profit; but this was due to dearer coal. Gas sales had increased nearly 12 million cubic feet—from 229⅞ to 241 million cubic feet; while the number of consumers, at 10,882, was 337 higher. With their residuals they had done splendidly. The Directors hoped that by the time of the next meeting the price of coal would have fallen, so that they might be able to accomplish what they were most anxious to do—reduce the price of gas. The Directors, officers, and workmen were thanked for the care with which they had conducted the affairs of the Company.

Free Gas Appliances in Manchester.—In the course of an interview with a representative of the "Manchester Guardian," Mr. William Kay, the Chairman of the Manchester Corporation Gas Committee, said there were indications that the Committee's policy of letting out cookers free is answering the expectations formed in regard to it. "So well," in fact, he declared, "has our policy in regard to cookers and gas fires succeeded that the Committee are considering the desirability of arranging for the provision of water-heating devices free of hire cost." That householders can buy these appliances for themselves he admitted; but he said "they want a little encouragement, and this the Gas Committee can give—with advantage to their department and pleasure to the householders.

Satisfaction at Normanton.—That the accounts for the past half year were of a very satisfactory character was the gratifying announcement made by the Chairman (Mr. J. Armitage) at the meeting of the Normanton Gas Company. Gas sales showed an increase of 3½ million cubic feet; and the working results were the best the Company had ever known—thus compensating them for the enhanced price of coal. They had, he added, every reason to be proud of having such a Manager and Secretary as Mr. E. H. Hudson. The works had gone ahead ever since he took charge; and the results had improved year after year. It was a good thing for the Company when Mr. Hudson commenced his career at Normanton. The profit, at £2498, was £298 up. The report was adopted; and a dividend for the half year was declared at the rates of 6 per cent. on the original stock and 4½ per cent. on the additional stock—a sum of £300 being transferred to the reserve fund out of the divisible profits.

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Watford Gas Company.

In the report presented at the half-yearly general meeting of this Company last Thursday, the Directors stated that there had been a satisfactory increase in the sale of gas in the six months ended the 30th of June, and that exceptionally good prices had been obtained for residuals. The revenue account showed a profit of £4907, and the profit and loss account a balance of £4744 available for distribution. The Directors recommended dividends at the rates per annum of £7 7s. 6d. per cent. on the "A" stock and £5 17s. 6d. per cent. on the "B" stock, less income-tax. The Chairman (Mr. E J. Slinn), in moving the adoption of the report, said the chief item of capital expenditure in the half year had been £8738 for new plant, the greater part of which was for a gasholder, which they had not started a moment too soon, as by about Christmas next their ordinary make of gas would be well over 300 million cubic feet per annum, and the contents of the present holder would be used up in one day. The expenditure on coal and oil showed an increase of nearly 20 per cent.; and with the higher price very careful and economical working was necessary in order that they might not have to raise the charge to the consumers. He noticed that two colliery companies were paying dividends of 50 per cent., and one paid 70 per cent.; so evidently coal-getting was a profitable business. The accounts showed that the co-partnership system benefited both employers and employees; and this was also proved by the faithful and willing service given by the co-partners. The sale of gas brought them £16,733 —an increase of 5 per cent. Residuals showed an increase of £1264; and but for this the increased cost of coal would have forced up the price of gas. The capital now stood at the low figure of £500 for every million cubic feet of gas sold; and when he mentioned that the figure for the largest Gas Company in the kingdom was £550, they would see how excellent this was. Their leakage was well under 5 per cent., which meant that there was most careful and painstaking supervision. The report was adopted, and the dividends recommended were declared. The Directors and staff having been cordially thanked, the Secretary and General Manager (Mr. J. Duncan Royal) said the staff greatly appreciated the vote, coming as it did from business men.

Winchester Water and Gas Company.—At the half-yearly general meeting of this Company last Thursday, the Directors reported that the receipts from the sale of water continued to show a satisfactory increase, but the gas receipts were slightly reduced, consequent on the recent reduction in price. The balance available for distribution was £9036; and the Directors recommended the payment of a dividend on the preference stock at the rate of 4 per cent. per annum, and on the consolidated ordinary stock at the rate of 4¼ per cent. per annum (less income-tax) for the half year. The Engineer and General Manager (Mr. H. C. Head, Assoc.M.Inst.C.E.) certified that the whole of the Company's plant had been maintained in a thorough and efficient condition.

The Blackpool Gas Managership.

Last Wednesday, the General Purposes Committee of the Blackpool Corporation disapproved of a recommendation of the Gas Committee that Mr. William Chew, son of the retiring Gas Engineer, and at present Assistant Engineer, should be promoted to the position of Chief Engineer, and that Mr. John Chew, jun., his son, should be appointed Assistant Engineer. After a long debate, it was decided to advertise the post of Engineer, as a protest against the hereditary principle, which it was stated had been too often observed at Blackpool. In the course of the debate, Alderman Grime, who is a member of the Sub-Committee entrusted with the task of selecting a successor to the retiring Engineer, said that, when he went down to the works with the Sub-Committee, he did so with a fixed resolve to oppose any appointment without competition; but he was so impressed with the way in which Mr. William Chew and Mr. John Chew, jun., answered all questions and gave practical demonstrations of their abilities and knowledge of the work, that his resolve was completely broken down. As the result of the decision of the General Purposes Committee, the Gas Committee held a special meeting at which it was decided to advertise for a Gas Manager at a salary of £400 per annum. The matter will, we understand, come up for confirmation at the usual meeting of the Council to-day.

Ryde Gas Company.—It was stated in the report submitted at the annual meeting of the Ryde Gaslight Company last Thursday that the accounts for the year ended June 30 showed an available balance on profit and loss account of £5848. The Directors recommended the declaration of a dividend for the twelve months, less income-tax, at the maximum sliding-scale rate of 5¾ per cent. To provide for future renewals and repairs, it had been decided to open a renewal fund, and a sum of £775 had this year been transferred thereto from the revenue account. The sales of gas exhibited an increase of over 2 million cubic feet.

Tonbridge Gas Company.—The half-yearly meeting of this Company was held on Monday last week, under the presidency of Mr. W. Judd. The Engineer and Secretary (Mr. J. Donaldson) showed that all the items of income had increased; and the profit for the half year was £2578. Dividends at the rates of 13¾, 10¾, and 5 per cent. per annum were declared. A vote of thanks was accorded to the Engineer, Assistant-Manager (Mr. J. H. Donaldson), and staff for their services. Mr. Judd, who proposed the vote, said they had to thank their Manager for the improvements and economies effected in the works; all the plant being now of the most up-to-date character. Mr. Donaldson, in acknowledging the vote, referred to the appointment of his nephew and assistant as Manager of the Sevenoaks Gas Company, which he regarded as a compliment to the Tonbridge Gas Company. A vote of thanks to the Chairman and Directors brought the proceedings to a close.

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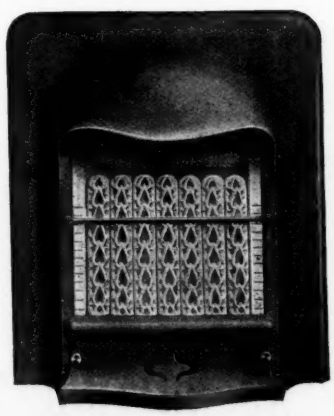

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Gas Affairs in the Near East.

A correspondent from Constantinople has sent us a cutting from a local French paper, of which the following is a translation: According to a contract made between the authorities of the City and the Minister of Finance, the Dolma-Bagtché Gas-Works had been transferred to the Municipality. As the works owed a certain sum of money to their employees, it was agreed that the Municipality should collect all outstanding debts, and pay their workmen. The money was accordingly collected; and the wages owing were about to be paid, when the authorities of the military gas-works, who had previously managed the works now in question, stepped in and wished themselves to hand over the money to the workmen. Naturally the Municipality rejected the proposition, wishing to do the paying themselves, in order to please the workmen who were actually in their employ, and who could at any time make things very unpleasant so long as money was owing to them. But the military authorities were not to be opposed, and sent and seized by force the 70,000 piastres which were locked up at the Prefecture. The question was finally referred to the Commander of Constantinople, and the necessary communications have been made to the Minister for War.

Reduction in Price at Altrincham.—In the report which was submitted at the half-yearly meeting of the Altrincham Gas Company, the Directors stated that the sales of gas showed an increase of nearly 6 million cubic feet. As from the end of March the price of gas was reduced 1d. per 1000 cubic feet; and a similar reduction has been announced as from June 30—making 3d. per 1000 cubic feet off the price in eighteen months. The balance of £12,235 was sufficient to provide for the full statutory dividends and leave £8581 to be carried forward.

Woking Water and Gas Company.—The accounts of this Company for the six months ended the 30th of June which will be presented at the half-yearly general meeting to-day show that the balance at the credit of the profit and loss account is £7183, out of which the Directors recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax. This will absorb £4753, and leave £2430 to be carried forward. During the half year, 82 additional house and 23 meter connections were made, and the service-mains extended about 350 yards.

Melbourne Metropolitan Gas Company.—The net profits of this Company for the six months ended the 30th of June, including a balance of £31,940 brought forward, amounted to £132,060. The Directors have transferred to the reserve fund account £26,000, to the meter renewal fund £4500, and to the gas-stoves, &c., account £3000; and they recommend a dividend at the rate of 6s. 6d. per share, leaving £42,842 to be carried forward. The price has been reduced from 4s. 7d. to 4s. 4½d. per 1000 cubic feet as from the July readings of the meters, which began on the 12th ult.

Truro Gas Company and Electricity Supply.—At the annual meeting of this Company last Saturday, the Directors reported a gratifying increase in the general business. They expressed regret that the Company's application to the Board of Trade for a Provisional Order to supply electricity in Truro and the district proved unsuccessful; the Board of Trade having decided to grant the Order to the Truro Corporation, subject, however, to the insertion of the Winchester clause. While the Directors considered the Company would naturally be in a better position to give a cheaper and more efficient electricity supply than the Corporation, they felt that, with the protection of the Winchester clause, the interests of the Company, in common with other ratepayers, were, to some extent, safeguarded. The balance standing to the credit of the profit and loss account, amounting to £2213, the Directors recommended should be appropriated in paying a dividend at the rate of 5 per cent. per annum, and the carrying forward of the balance, less income-tax.

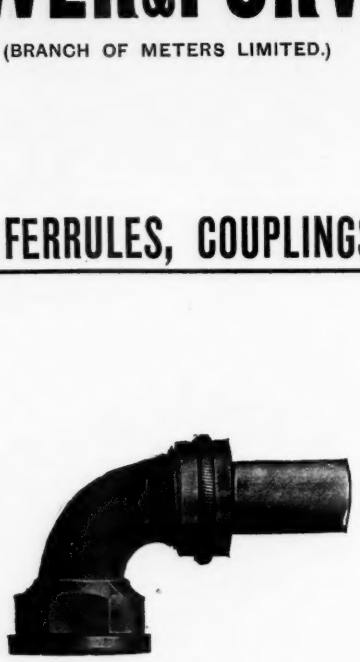
Doncaster's New Water Supply.—The result of the negotiations between the Corporations of Leeds and Doncaster in reference to the proposal to supply the latter place with additional water shows that the Doncaster Corporation have agreed to take a supply from Leeds commencing with 500,000 gallons a day, with the right to increase to 2 million gallons when required. The Leeds Corporation will bring the water from Leighton to their Moortown reservoir, and after being filtered it will be pumped into a line of pipes passing through Scholes, Aberford, and Ferrybridge to Doncaster. A service reservoir will be constructed to hold about 9 million gallons of water. The cost of laying the pipes and the erection of the reservoir will be borne by the Leeds Corporation, who intend to apply for statutory powers, and are at present making the necessary surveys and preparing plans for the purpose. The object of the Leeds authorities is, it is understood, to supply not only the borough of Doncaster and the area under the jurisdiction of the Corporation, but also other authorities who happen to be on the line of route.

Water for Fire Extinction at Aldershot.—In the course of a discussion in the Aldershot Town Council on the question of the insurance of the property of the Corporation against fire, Mr. Solomon, who was for many years Chief Superintendent of the Fire Brigade, spoke in very favourable terms of the water-supply arrangements of the Aldershot Gas, Water, and District Lighting Company. He said he had been connected with the Fire Brigade for more than twenty-five years, and during that time he did not remember having received one call to any building belonging to the ratepayers. Further, the town itself had very few cases of fire. In the reports it was shown that Aldershot had less claims than any other town of the same population during a given period. Then they had an efficient Fire Brigade, and the Gas and Water Company had put down some of the finest mains that any town could wish for; and he could guarantee that, if the Council were to canvass the town, the ratepayers would be found to agree with their wish to raise a reserve fund for the insurance of their own property.

SAWER & PURVES

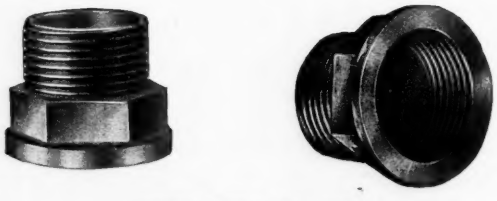
(BRANCH OF METERS LIMITED.)

BRASS FERRULES, COUPLINGS, &c.



STOVE BEND No. 112.

STOVE BEND No. 111.



STOP CAPS No. 155.

YOUR ENQUIRIES ARE SOLICITED.

MILES PLATTING, RADFORD ROAD,

MANCHESTER AND NOTTINGHAM.

Douglas Gas Company.—It was reported at the half-yearly meeting of the Douglas Gaslight Company that the profit for the six months amounted to £4244; and a dividend of 32s. 6d. per share was declared. Though the cost of coal had been greater, the profit, owing to the continued expansion of the business, was only £8 less than for the corresponding period of last year. The Directors' fees were increased; and a suggestion was put forward that, in view of the increased cost of living, some addition should be made to the wages of workmen of the Company.

Harrogate Gas Company.—The half-yearly meeting of this Company was held last Wednesday—Mr. F. Barber in the chair. The business consisted simply of the declaration of the interim dividends; but the Chairman made a few general remarks. He said he was glad to state that the sound progress of the Company's business had been well maintained during the first six months of the present year; the quantity of gas sold being 2,510,000 cubic feet more than for the corresponding period of the previous year. If the same progress were maintained to the end of the year, the margin of profit earned would be ample to sustain the dividends at their present rate and to meet the serious increase in the cost of coal without raising the price of gas. He had, therefore, no doubt, with their reserve fund and balance on the net revenue account, that the policy of the Board in reducing the price from the 1st of April last would be fully justified. Though the consumers of gas were entitled to a much larger share in the profits of the undertaking than were the proprietors, he often doubted whether they showed any due appreciation of the fact. For every £340 8s. 4d. paid as increased dividend to the proprietors, £1086 must be allowed to the consumers in the reduced price of gas. If the consumers could only see how very much more they benefited from the prosperity of the Company than they did as investors in its stock at a very modest rate of interest, they would not only refrain from carping criticism, but would do all they could to promote the prosperity of the undertaking for their common benefit. The interim dividends were declared.

Additional Capital for the Leatherhead Gas Company.—It will be seen, from an announcement elsewhere, that the Directors of the Leatherhead Gas Company are prepared to receive tenders for 600 shares of £10 each and £2000 of 4 per cent. debenture stock, part of the additional capital authorized by the Company's Act of 1912. The minimum price of issue is par. The Company's district comprises Leatherhead and several other places; and the present issue of capital is required to meet the cost of the new high-pressure gas-main between Leatherhead and Cobham, recently referred to in the "JOURNAL" [*ante*, p. 455], and for the general development of the area. The sale of gas last year reached a total of 56½ million cubic feet, including 16½ millions in the new Cobham area; the increase in the latter being at the rate of 50 per cent.—*i. e.*, from 11 to 16½ million cubic feet—since its possession by the Company.

Failure of a Water Engineer.—In the King's Bench Division of the High Court of Justice last Tuesday, Mr. Ernest Collins, who was adjudicated a bankrupt on the 5th ult., attended for public examination; his statement of affairs showing gross liabilities £29,100, and an estimated surplus in assets of £1479. In reply to Mr. E. Leadam Hough, the bankrupt said he was a civil engineer, and up to September, 1911, was in the service of the Metropolitan Water Board at a salary of £1750 a year. In that month he retired, and was now receiving a pension of £904 a year. Between 1904 and 1911, he was a Director of the British Railway and General Construction Trust, Limited, afterwards called the Dominion Land, Loan, and Mercantile Agency, Limited, which in 1911 went into liquidation. In May, 1904, he also became a Director of the British Columbia Development Association, Limited, which was formed to acquire property and promote commercial enterprises in British Columbia and elsewhere. He retained this directorship until July, 1912, when an order was made for the compulsory winding-up of the Company. His failure was entirely due to liabilities incurred on behalf of these Companies. The examination was adjourned.

GAS COMPANIES' STOCK AND SHARE LIST.

The week just closed on the Stock Exchange has not been at all a bad one on the whole. It is true that business showed no increase of activity over the preceding six days, that Foreign affairs now and then were calculated to give rise to some concern, and that labour questions were not shaping satisfactorily. But still markets did very well. The firmness of the gilt-edged market was a prominent feature; and the finish-up of the week was quite cheerful. Departments in general re-opened on Monday a good deal brighter than they had closed on the previous Friday. Business was very quiet, but a fair amount of buying, prompted by increased confidence in the outlook of affairs, sent prices up. Government issues were firm, and Consols were strong, aided by cheaper money. Rails were quite bright and advanced uniformly; while Americans improved. The seasonable inactivity was not disturbed on Tuesday by the fact of the fortnightly settlement commencing. The tendency was rather good, especially in some of the leading markets; Foreign politics not appearing eruptive. Gilt-edged were stronger, and rails quite firm; but Americans weakened a little. Foreign quotations were mostly higher. On Wednesday, there was some little vitality in one or two minor lines; but the chief markets were steady, and with little variation. Government issues were quite passive. Rails were disinclined to move, balanced between good traffics and labour doubts. Foreign were firm. On Thursday, the settlement took the front place. The tone was dull at first, owing to misgivings regarding Foreign affairs, and markets in general were weaker. But a smart rally took place later in gilt-edged lines, and Consols became firm. Rails did not participate, owing to the aspect of labour questions. On Friday, the tone of all the chief markets showed a great improvement; and not even Friday realizations could quench the cheerfulness. Easier money continued to aid gilt-edged, and Government issues rose. Rails remained quiet, with an eye to labour movements; but, in spite of this, some quotations advanced. Saturday was as quiet as usual; and the most noteworthy feature was a further rise in Consols, which closed at 74¼ to 74⅜—a gain of 7/16 in the week. In the Money Market, the supply was ample, and all demands were met with ease. Business in the Gas Market was a very fair average for the time of year, and was fairly distributed among the various classes of undertakings. The tone was quite firm. In Gaslight and Coke issues, the ordinary was well dealt in at steady figures, ranging from 101¼ to 102¼. In the secured issues, the maximum changed hands at 75⅛ to 76⅜, the preference at 95, and the debenture at 74 to 74½. South Metropolitan marked from 109 to 110 (a rise of ½), and ditto debenture 73¼ to 73⅝—a rise of 1. In Commercials, the 4 per cent. realized 105½ *ex div.*, the 3½ per cent. 104½ *cum div.* and 102½ *ex div.*, and the debenture 71⅛ and 72. Among the Suburban and Provincial group, Bournemouth "B" made 15 9/16 *cum div.* and 15 *ex div.*, ditto preference 13⅜ *ex div.*, British 45⅝, and South Suburban 114 to 115. In the Continental companies, Imperial marked 163½ to 164, and European 18⅛ and 18¼. Among the undertakings of the remoter world, Bombay fetched 6⅜, Oriental 128, Primitiva 6 5/16, ditto preference 5 to 5 5/32, and River Plate debenture 90½.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 11	5	Alliance & Dublin Ord.	63–68	..	7 7 1
374,000	,,	July 11	4	Do. 4 p.c. Deb.	80–83	..	4 16 5
280,000	5	April 11	7½	Bombay, Ltd.	6¼–6⅝	..	5 11 1
50,000	10	Aug. 28	15	Bourne- mouth Gas and Water	10 p.c.	28–29*	.. 5 3 5
					B 7 p.c.	14⅞–15½*	.. 4 11 10
					Pref. 6 p.c.	13½–13⅝*	.. 4 7 3
880,000	Stk.	Aug. 14	14	Brentford Consolidated		259–264	.. 5 6 1
880,000	,,	,,	11	Do. New		196–201	.. 5 9 5
50,000	,,	,,	5	Do. 5 p.c. Pref.		111–113	.. 4 8 6
206,250	,,	June 13	4	Do. 4 p.c. Deb.		94–96	.. 4 3 4
217,380	Stk.	Aug. 28	11	Brighton & Hove Orig.		201–206*	+½ 5 6 10
244,200	,,	,,	8	Do. A Ord. Stk.		148–151*	+1 5 6 0
530,000	20	Mar. 28	12½	British		45–46	.. 5 8 8
120,000	Stk.	June 27	4	Do. 4 p.c. Deb. Stk.		87–89	.. 4 9 11
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.		83½–91½	.. 4 7 5
100,000	10	—	—	Cape Town & Dis., Ltd.		2–3	.. —
100,000	10	—	—	Do. 4½ p.c. Pref.		4–5	.. —
100,000	Stk.	June 27	4½	Do. 4½ p.c. Deb. Stk.		75–80	.. 5 12 6
157,150	Stk.	Aug. 14	5	Chester 5 p.c. Ord.		107–109	.. 4 11 9
1,513,280	Stk.	Aug. 28	5/9/4	Commercial 4 p.c. Stk.		105–107*	+3/4 5 2 1
560,000	,,	,,	6⅔	Do. 3½ p.c. do.		102–104*	+⅝ 5 2 6
475,000	,,	June 13	3	Do. 3 p.c. Deb. Stk.		71–73	.. 4 2 2
800,000	Stk.	,,	4	Continental Union, Ltd.		80–83	.. 4 16 5
200,000	,,	,,	7	Do. 7 p.c. Pref.		124–126	.. 5 11 1
492,270	Stk.	—	5	Derby Con. Stk.		123–124	.. 4 0 8
55,000	,,	—	4	Do. Deb. Stk.		102–104	.. 3 16 11
1,002,180	10	July 30	10	European, Ltd.		17½–18½	.. 5 8 1
16,386,660	Stk.	Aug. 14	1/17/4	Gas-light and Coke	4 p.c. Ord.	101–103	.. 4 14 6
					3½ p.c. max.	74–77	.. 4 10 11
					4 p.c. Con. Pref.	93–96	.. 4 3 4
					3 p.c. Con. Deb.	73–75	.. 4 0 0
4,674,850	,,	June 13	3	Hastings & St. L. 3½ p.c.		89–91	.. 5 9 11
258,740	Stk.	Mar. 13	5	Do. do. 5 p.c.		—	.. —
82,500	,,	,,	6½	Hongkong & China, Ltd.		17¼–17⅝	.. 6 3 11
70,000	10	April 25	11	Ilford A and C		152–155	.. 4 18 4
131,000	Stk.	Mar. 13	7⅛	Do. B		120–122	.. 5 0 5
65,780	,,	,,	6⅛	Do. 4 p.c. Deb.		89–91	.. 4 7 11
65,500	,,	June 27	4	Imperial Continental		162–167	.. 5 7 9
4,940,000	Stk.	May 16	9	Do. 3½ p.c. Deb. Red.		83–85	.. 4 2 4
1,235,000	Stk.	Aug. 14	3½	Lea Bridge Ord. 5 p.c.		118–121*	.. 5 3 4
200,242	Stk.	Aug. 28	6½	Liverpool United A		203–205*	.. 4 17 7
561,000	Stk.	,,	10	Do. B		141½–143½*	.. 4 17 7
718,100	,,	,,	7	Do. Deb. Stk.		96–98	.. 4 1 8
806,083	,,	June 27	4	Maidstone 3 p.c. Deb.		66⅛–68⅛	.. 4 7 7
63,480	Stk.	June 27	3				

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
75,000	5	June 13	6	Malta & Mediterranean	4⅜–4⅞	..	6 3 1
250,000	100	April 1	4½	Met. of Melbourne	4½ p.c. Deb.	98–100	.. 4 10 0
541,920	20	May 30	4	Monte Video, Ltd.		12¾–13	.. 6 3 1
1,775,892	Stk.	July 30	4½	Newc'tle&G'tesh'd Con.		97½–98½	+1 4 11 5
529,705	Stk.	June 27	3½	Do. 3½ p.c. Deb.		83½–84½	.. 4 2 10
55,940	10	Aug. 28	7/10,6	North Middlesex 7 p.c.		12⅝–13⅜*	.. 5 11 5
800,000	Stk.	May 16	8	Oriental, Ltd.		124–129	.. 6 4 0
60,000	5	Mar. 28	10	Ottoman, Ltd.		2 1/4–2 3/4	.. 5 14 3
60,000	50	Aug. 14	13	Portsea, Island B		122–125	.. 5 6 1
100,000	50	,,	12	Do. C		119–122	.. 4 18 4
249,980	5	May 16	8	Primitiva Ord.		6–6⅛	.. 6 3 1
499,960	5	June 27	5	,, 5 p.c. Pref.		5–5½	.. 4 15 3
521,600	100	June 2	4	,, 4 p.c. Deb.		93–95	.. 4 4 3
346,198	Stk.	June 27	4	River Plate 4 p.c. Deb.		90–92	.. 4 7 0
275,000	5	Apl. 11	12	San Paulo, Ltd.		—	.. —
150,000	10	,,	6	Do. 6 p.c. Pref.		11¼–11⅝	.. 5 2 2
125,000	50	July 1	5	Do. 5 p.c. Deb.		48–50	.. 5 0 0
135,000	Stk.	Mar. 13	10	Sheffield A		225–227	.. 4 8 1
209,984	,,	,,	10	Do. B		225–227	.. 4 8 1
523,500	,,	,,	10	Do. C		223–225	.. 4 8 11
90,000	10	May 30	7½	South African		9½–10½	.. 7 2 10
6,429,895	Stk.	Aug. 14	5/9/4	South Met., 4 p.c. Ord.		108½–110½	+½ 4 18 11
1,895,445	,,	July 11	3	Do. 3 p.c. Deb.		73–75	+1 4 0 0
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.		157–159	.. 5 6 11
952,795	Stk.	,,	6	S'th Suburb'n Ord. 5 p.c.		114–116	.. 5 3 5
60,000	,,	,,	5	Do. 5 p.c. Pref.		113–115	.. 4 6 11
117,058	,,	June 27	5	Do. 5 p.c. Deb. Stk.		115–117	.. 4 5 6
594,740	Stk.	May 16	5	Southampton Ord.		102–105	.. 4 15 3
120,000	Stk.	Aug. 14	7⅜	Tottenham A 5 p.c.		136–139	.. 5 6 1
543,940	,,	,,	5⅝	and B 3½ p.c.		113–115	.. 5 2 2
149,470	,,	June 27	4	Edmonton 4 p.c. Deb.		90–92	.. 4 7 0
182,380	,,	,,	5	Tuscan, Ltd.		5–6	.. 8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.		94–96	.. 5 4 2
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.		112–113	.. 4 8 6
30,000	Stk.	Aug. 28	8⅜	Wandsworth, Wimbledon, and Epsom— A 5 p.c.		155–160*	.. 5 4 8
255,636	,,	,,	6⅝	,, B 3½ p.c.		129–134*	.. 5 2 7
108,075	,,	,,	5/17/3	,, C 3½ p.c.		110–115*	.. 5 2 0
352,000	,,	,,	6⅜	Wimbledon 5 p.c.		107–112*	.. 5 8 0
98,000	,,	,,	6⅜	Epsom 5 p.c.		114–119*	.. 5 11 4
88,416	,,	June 27	3	3 p.c. Deb. Stk.		68–70	.. 4 5 9

Prices marked * are "Ex-Div."

Last Friday evening, shortly after seven, Harrogate was visited by a thunderstorm. There was one very vivid flash of lightning, and almost at the same time the electric light failed, and was out for ten minutes.

At the next half-yearly general meeting of the British Gaslight Company, Limited, the Directors propose to recommend, subject to audit, a dividend at the rate of 10 per cent. per annum, with a bonus of 5s. per share (both less income-tax), for the half year to June 30.

The life story of Mr. William Collison, the Founder and General Secretary of the National Free Labour Association, as told by himself, has just been published by Messrs. Hurst and Blackett, Limited, of Paternoster Row, E.C. It was written, by request, in commemoration of the twenty-first anniversary of the formation of the Association.

The "Ironmonger" states that after a considerable amount of controversy over the requirements of cast-iron pipes for the Metropolitan Board of Water Supply and Sewerage for Sydney, the Minister for Public Works, after threatening to build a State pipe-works and also to import from abroad the pipes immediately required, has approved of the acceptance of the tenders of Messrs. G. & C. Hoskins, Limited, for the supply of pipes and special castings for a period of four years, at the schedule of prices submitted; but he maintains that at the end of the four years the State will have its own pipe-works, and be independent of private suppliers. The contract provides that the whole of the pipes and special castings shall be cast and completed at the works of the contractor, which it is expressly specified are to be situated in New South Wales.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments Vacant.

ENGINEERING DRAUGHTSMAN. No. 5781.
GAS ENGINEERING DRAUGHTSMAN. No. 5782.
TRAVELLERS AND AGENTS. B. A. List, 56, Cheapside, E.C.
ASSISTANT MANAGER AND SECRETARY. Tonbridge Gas Company.
CHEMIST. No. 5783.
ASSISTANT ENGINEER AND MANAGER. No. 5784.
STOKER. Thetford Gas-Works.
STOKER. Tenterden Gas-Works, &c.

Appointments, &c., Wanted.

SITUATIONS ABROAD. P. 9707, O. Thiele, Berlin.

Plant, &c. (Second-Hand), for Sale.

GAS-METERS. Mason, Gateshead-on-Tyne.
PURIFIERS, WASHER, EXHAUSTERS, AND RETORTS. South Suburban Gas Company.

Sales of Stocks and Shares.

LEATHERHEAD GAS AND LIGHTING COMPANY.

TENDERS FOR

Coal.

MALTON GAS COMPANY. Tenders by Sept. 16.

Gas Oil.

OLDBURY GAS DEPARTMENT. Tenders by Sept. 20.

Gas Plant.

PURIFIERS AND LIQUOR STORE TANKS. Coventry Gas Department. Tenders by Sept. 15.

Saturator.

STOURBRIDGE GAS DEPARTMENT. Tenders by Sept. 16.

Tar.

HEREFORD GAS DEPARTMENT. Tenders by Sept. 8.

Various Work.

CLECKHEATON URBAN DISTRICT COUNCIL. Tenders by Sept. 16.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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THE very best Patent Grids for Holding Oxide Lightly.
See Illustrated Advertisement, July 29, p. 336.

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